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VORHIES (C. T.) & WEHRLE (L. P.). **Pest Problems of the small Garden.**— *Bull. Ariz. agric. Exp. Sta.* no. 203, 50 pp., 12 figs., 3 refs. Tucson, Ariz., 1946.

This bulletin is devoted almost entirely to insects and contains information on the appearance, bionomics and control of the species that are liable to damage vegetables grown in home gardens in Arizona.

MARCOVITCH (S.). **Insects injurious to Sweetpotato Tubers in Tennessee.**— *Bull. Tenn. agric. Exp. Sta.* no. 202, 12 pp., 15 figs., 10 refs. Knoxville, Tenn., 1946.

The cause of the pinholes and pits observed in sweet-potato tubers in Tennessee was unknown for many years, but observations in 1945–46 showed that the larvae of *Systena elongata*, F., are mainly responsible. All stages of this flea-beetle are briefly described. In 1945, the larvae were found in the soil about sweet-potato tubers from late August to October. Adults were swept from the plots, and some were also taken, on 1st November, on *Plantago* and on dock (possibly *Rumex obtusifolius*). The species probably overwinters mainly in the larval stage. Larvae found in the soil near *P. lanceolata* on 23rd May 1946 fed on sweet potato in the laboratory. Pupae found under *Plantago* on 27th May, 3rd June and 20th August gave rise to adults on 5th and 13th June and 24th August. Adults were swept from sweet potato in June and early July, and eggs laid in the laboratory on 30th June hatched on 10th July. The larvae fed readily on sweet potato tubers and also ate small rootlets, but died on 4th August. Typical larval injury to tubers was observed in the field on 6th August, and a few larvae and two pupae were found on 16th September, one of the latter giving rise to a misshapen adult on 22nd September. Sweet potatoes dug on 7th October showed many holes, particularly near the edges of the field, where *Plantago* was growing. Since the larvae do not remain at the same place to feed but attack a different place each time, the injury is out of all proportion to their numbers.

Control by insecticides is impracticable owing to the long period over which the adults enter a sweet-potato field, so that clean cultivation and the destruction of weeds are the only means of protection. Sweet potatoes should not be grown in low-lying, wet ground, which favours larval development. Sweet potatoes in several areas were severely injured in 1942, which was a wet year, whereas damage was slight in 1944, when there were periods of drought.

Other insects that may cause subsidiary damage are *S. blanda*, Melsh., *Diabrotica duodecimpunctata*, F., *Typophorus viridicyaneus*, Crotch, and wireworms. *S. blanda* has been recorded from sweet-potato tubers in other States [*cf.* *R.A.E.*, A **15** 267], but has not been observed attacking them in Tennessee. Adults were found injuring various crops in 1946, including beans, cotton and radish, and were common on weeds, but larvae found under weeds or reared in the laboratory did not complete their development on sweet-potato tubers, though they fed to some extent. Adults were taken among sweet potato near infested weeds on one occasion. On 6th August, 1946, a larva of *D. duodecimpunctata* was found in the soil among sweet potatoes and fed readily on a tuber in the laboratory. Larvae that hatched in the laboratory on 23rd April fed on slices of sweet potato and sprouted maize, but grew more rapidly on maize ; they also fed on the roots and young tubers of sweet potato. Some of the larvae pupated on 15th May, and adults emerged on 19th. *T. viridicyaneus* has been recorded damaging sweet potato in various States [*cf.* **27** 285 ; **35** 23, 391], the adults feeding on the foliage and the larvae on the tubers. It is present at Knoxville and in central Tennessee. Injury by wireworms was observed during October 1944, and when examples found near

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sweet potato were placed on the tubers in the laboratory, they made holes in them. One of the wireworms found in plots of sweet potato in October appeared to be a species of *Melanotus*.

ISELY (D.). **The Cotton Aphid.**—*Bull. Ark. agric. Exp. Sta.* no. 462, 29 pp., 3 graphs, 37 refs. Fayetteville, Ark., 1946.

It is well known that outbreaks of *Aphis gossypii*, Glov., on cotton in the United States result from dusting with calcium arsenate, which kills the natural enemies that normally keep the Aphid in check [*cf. R.A.E.*, A **16** 268]. If it is not applied, injury normally occurs early in the season only and is usually outgrown. The effect of other factors in promoting outbreaks was investigated in Arkansas in experiments begun in 1936. The chief food-plants of the Aphid there are Malvaceae and cucurbits, but though outbreaks have occurred on cucurbits as well as on cotton, there is no evidence of migration from either plant to the other. Attempts to establish Aphids from either of them on the other were unsuccessful [*cf.* also **8** 501], which suggests that separate biological races may be involved.

Rearing experiments under controlled conditions showed that the development of *A. gossypii* on cotton is accelerated by an increase in mean temperature between 17°C. (62·6°F.) and 28°C. (82·4°F.). The time required for nymphal development averaged 8·65 days at 18°C. (64·4°F.) and 5·18 days at 28°C. Scanty records suggest that a mean temperature of 29°C. (84·2°F.) and above may retard development. Reproduction was most rapid at 20°C. (68°F.), when the average daily number of offspring per Aphid was 2·69, though the average declined only slightly at higher or lower temperatures. The average total number of offspring was highest (63·73) and the average length of the reproductive period greatest (26·53 days) at 19°C. (66·2°F.). Limited tests to ascertain the effect of soil moisture showed that populations increased more rapidly on plants regularly watered than on those subjected to artificial drought.

Tests to ascertain the effect of soil nutrients showed that Aphids required slightly less time for development on cotton grown in a sand culture watered with a complete nutrient solution than on plants watered with a nutrient solution containing only 10 per cent. as much nitrogen or 5 per cent. as much potassium. When the nutrient solution was deficient in nitrogen, the average number of offspring produced daily was reduced by about 12·5 per cent. and the total offspring by 16·5 per cent., which was not so great a reduction as might be expected from differences in infestation observed in the field. The slight reductions due to potassium deficiency were not significant. A stimulating effect of nitrogen on the abundance of Aphids on dusted cotton has been observed [**32** 132], and it is thought that the increase of nitrogen in the soil in Arkansas that has resulted from the greater use of leguminous plants as green manure in recent years is likely to result in a greater tendency to Aphid outbreaks on cotton dusted with calcium arsenate. There were no significant differences in the rates of development and numbers of offspring produced on plants grown in soil treated with sulphur at 300 lb. per acre or lime at 2,000 lb. per acre.

In a greenhouse test to compare the rate of development and fecundity of Aphids on untreated plants and plants dusted with calcium arsenate, lead arsenate and hydrated lime, carried out in view of the suggestion that calcium arsenate is itself a stimulant through its effect on the cell sap [*cf.* **30** 264], development was most rapid on plants dusted with lead arsenate and slowest on those dusted with calcium arsenate, but the extreme difference was only about half a day. Total fecundity was very slightly greater on plants dusted with lead arsenate and very slightly less on those dusted with hydrated lime or left untreated than on those that received calcium arsenate.

Outbreaks of *A. gossypii* can be controlled by adding 3 per cent. nicotine, usually in the form of nicotine sulphate, to the calcium-arsenate dust. For control of the Aphid alone, nicotine can be applied in hydrated lime. In a limited experiment, 0·5 per cent. rotenone in calcium arsenate appeared to give effective control provided that it was applied to the undersides of the leaves and came into actual contact with the Aphids. Details are given of tests already noticed in which sulphur dusts were also effective against Aphids that came into contact with them [**35** 181].

YASUMATSU (K.) & YOSHIMURA (S.). **Some Chalcidoid Parasites of** *Saissetia nigra* **and** *S. hemisphaerica* **in Micronesia (Hymenoptera).**—*Mushi* **16** pt. 7 pp. 29–34, 1 fig. Fukuoka, 1945.

Saissetia nigra, Nietn., and *S. coffeae*, Wlk. (*hemisphaerica*, Targ.) are among the commonest Coccids in Micronesia, and investigations on their parasites were made in the spring of 1940 in the Marianna and Caroline Islands. The Pteromalid, *Tomocera californica*, How., was reared from *S. nigra* on *Terminalia catappa* in Saipan, Marianna Islands, and the Aphelinid, *Aneristus ceroplastae*, How., was reared from *S. coffeae* on *Gardenia* in Truk, Caroline Islands, and from *S. nigra* on a fern in Saipan and collected on the leaves of *Gardenia* infested by *S. coffeae* in Pagan, Marianna Islands. The world distribution and known hosts of these two parasites are given.

The Encyrtids, *Clausenia saissetiae* and *Eucomys saissetiae*, spp. n., are described from females collected in association with *Tomocera californica* on leaves of *Terminalia catappa* infested by *S. nigra* in Saipan. They may be parasites of *S. nigra*.

GADD (C. H.). *Macrocentrus homonae*—**a polyembryonic Parasite of Tea Tortrix (***Homona coffearia***).**—*Ceylon J. Sci.* (B) **23** pt. 2 pp. 67–79, 1 pl., 8 refs. Colombo, 1946.

Macrocentrus homonae, Nixon, which was introduced into Ceylon for the control of *Homona coffearia*, Nietn., on tea, has reduced the latter to the status of a minor pest [*cf. R.A.E.*, A **30** 418]. Laboratory investigations on the bionomics of this Braconid, which are described in detail, show that its great efficiency is partly due to the fact that it is polyembryonic [*cf.* **33** 300], like *M. gifuensis*, Ashm. [*cf.* **19** 436], which it closely resembles in structure and habits.

H. coffearia, the life-history of which is reviewed [*cf.* **22** 166], is liable to be parasitised by *M. homonae* at any time during the larval stage, which lasts 5–6 weeks at altitudes above 4,000 ft. and about 26 days at 1,500 ft. Of 57 larvae collected on an estate in March 1943, 44 were found to be parasitised by *M. homonae*; 27 of these yielded 295 adult parasites, of which 178 were females.

Stocks of *M. homonae*, the four larval instars of which are described, were bred in the laboratory and the adults were kept in jars and supplied with water, dilute sugar solution and split raisins. Larvae of *H. coffearia* that were to be parasitised were placed on young tea shoots so that typical nests of webbed leaves could be made; after they had been parasitised, they were transferred to other jars with fresh shoots. The mode of oviposition by the parasite is described in detail [*cf.* **33** 300]. The female was attracted to a nest of webbed leaves whether it contained a larva or not, but did not attack larvae that left their nests. Artificial nests containing frass or faecal pellets of *H. coffearia* or of other Lepidopterous larvae were slightly attractive, but freshly excreted pellets were not. The eggs probably hatch in 10–11 days, though dissection of numerous parasitised larvae revealed no trace of eggs

within 10 days of attack. The larvae attained the last instar 17 days after oviposition and emerged from the host two days later, killing it in doing so. They then consumed almost the whole of its body and spun their cocoons in a more or less compact mass from which the adults emerged after 11–17 days.

To ascertain the number of larvae resulting from a single stab by the parasite, a female of *M. homonae*, three days old, was placed in a cage with successive larvae of *H. coffearia*, most of which were removed as soon as they had been stabbed once ; after an interruption of three days, the experiment was continued, and at least 13 days after being stabbed, the host larvae were dissected. Nine of 12 larvae stabbed on the first day and 13 of 14 stabbed on the second contained parasites, the total numbers found in them being 302 and 521. From the 18 that were stabbed only once, 512 parasites were obtained, giving an average of 28·4 per host or per stab. When the ovaries of females three days old were dissected, not more than 25 well-developed eggs were found in any one ovary, indicating that not more than 50 eggs are likely to be laid by such females. It is therefore concluded that the 302 larvae that resulted from the egg-laying of one female three days old cannot each have originated from a single egg and that the species is polyembryonic. A further indication of polyembryony was the fact that batches of parasites reared from hosts not known to have been stabbed only once were frequently unisexual.

Since larvae of *H. coffearia* may be parasitised at any age, tests were carried out to determine the influence of the age of the host at the time of parasitism on the development of the parasites and on the further development of the host itself. The results showed that when the larvae were attacked young, the parasites emerged from them at about the time when the hosts would have pupated had they not been parasitised, but that when nearly full-fed larvae were attacked, the larval stage was prolonged for about 10 days beyond the normal, during which the larva continued to feed as usual until the parasites emerged from it ; in one instance, when the host pupated at the normal time, it and the parasites it contained all died.

GADD (C. H.), FONSEKA (W. T.) & RANAWEERA (D. J. W.). **Parasites of Tea Nettlegrubs with special Reference to** *Platyplectrus natadae* **Ferrière and** *Autoplectrus taprobanes* **Gadd.**—*Ceylon J. Sci.* (B) **23** pt. 2 pp. 81–94, 1 pl., 1 fig., 5 refs. Colombo, 1946.

Of the five species of Euplectrine Eulophids that have been recorded as parasitising nettlegrubs (Limacodids) on tea in the Passara district of Ceylon, *Neoplectrus maculatus*, Ferrière, and *Platyplectrus natadae*, Ferrière, are the commonest, *Metaplectrus thoseae*, Ferrière, and *M. solitarius*, Gadd, have not been taken recently, and *Autoplectrus taprobanes*, Gadd, had been collected only once, from larvae of *Spatulifimbria castaneiceps*, Hmps., previous to April 1944, when three females were obtained from *Thosea cervina*, Moore [*cf. R.A.E.*, A **34** 46–47]. A detailed account is given of laboratory investigations on the habits of *P. natadae* and *A. taprobanes*, which in many respects closely resemble those of *N. maculatus* [*cf.* **34** 324] ; the eggs, larvae and adults of these two species are described, and a key to the adults of all five species is appended.

The parasites were kept in the same way as *Neoplectrus* [*cf.* **34** 324] and the host insects were chiefly laboratory-reared larvae of *Natada nararia*, Moore, from which *Platyplectrus* has often been recorded [*cf.* **33** 300] as well as from *Thosea recta*, Hmps., *T. cervina* and *Narosa conspersa*, Wlk., but on which *Autoplectrus* had not been found in nature. When equal numbers of larvae of *Natada* and *Thosea* were offered simultaneously to a female of *Autoplectrus*, both were attacked in the same manner, and *Natada* was sometimes attacked

when unparasitised larvae of *Thosea* were available ; it is thought that the size of a larva and its spines may be the major factor in deciding whether it will be parasitised by *Autoplectrus* and *Platyplectrus*.

Adult males and females of *Platyplectrus* lived for up to 209 and 132 days, respectively, and those of *Autoplectrus* for up to 237 and 150 days, when provided with sweetened water. The females also fed on the body fluids of host larvae ; the males did not, but survived for only a few days when deprived of carbohydrates. When various flowers were presented to the males instead of sugar solution, only those of *Dolichos lablab* and *Tephrosia candida* proved suitable as a source of carbohydrates for *Autoplectrus*. Mating by either species was not observed, and three females of *Autoplectrus* produced only male offspring, though males of the filial generation were caged with them as soon as available. One egg laid by a female of *Platyplectrus* gave rise to a female, indicating that mating had occurred, but this female in turn produced only male offspring although males were present in the cage.

Females of *Platyplectrus* and *Autoplectrus* attack the host in the same manner, and the process is described in detail. They immobilise the host larva by puncturing it with the ovipositor before making feeding punctures or ovipositing. The feeding puncture causes the body fluid to exude, but the punctures in larvae on which eggs are laid do not. Larvae on which eggs have been laid remain inactive for up to 15 minutes, after which they move and feed normally until the eggs hatch, but they die as soon as the parasite larvae begin to feed. Females of *Platyplectrus* killed on the average one larva for feeding purposes for every four eggs laid, and those of *Autoplectrus* one for every six eggs laid. The former laid an average of 0·7–1·3 and the latter 2–2·8 eggs per day, depending largely on the number of days on which suitable hosts were offered ; the totals ranged up to 60 for *Platyplectrus* and 142 for *Autoplectrus*. Eggs of *Platyplectrus* and *Autoplectrus* hatched in averages of 4·2 and 2·4 days, respectively. The larvae fed for 3–8 days on the body contents of the dead host, which remained fluid. When full-fed, they pupated under the exoskeleton of the host and gave rise to adults in 7–13 days.

In nature, Limacodid larvae are rarely seen bearing more than one parasite egg ; in the laboratory, up to seven eggs were observed on one larva, but although several eggs may hatch, only one larva usually reaches maturity. When eggs are laid on hosts previously attacked by the internal parasite, *Fornicia ceylonica*, Wlkn., the latter always succumbs and the *Platyplectrus*, *Autoplectrus* or *Neoplectrus* larva survives. Hyperparasites are rare, but a species of *Tetrastichus* has recently been recorded from *Platyplectrus* [*cf.* **35** 3]. When the nettlegrub larvae develop wilt disease before the parasites are full-fed, the latter do not mature.

TREHAN (K. N.) & PHATAK (V. V.). **Life-history and Control of Betelvine Bug (*Disphinctus maesarum* Kirk.).**—*Poona agric. Coll. Mag.* **37** no. 1 repr. 8 pp. Poona, 1946.

Severe damage to betel (*Piper betle*) by *Disphinctus maesarum*, Kirk., has been reported for some time from the Bassein area of Bombay Province, where this crop is cultivated extensively. Even 5 per cent. damage to the leaves causes considerable loss, but the damage is sometimes much greater. Both adults and nymphs feed on the tender, succulent parts of the vine, and a toxin is injected into the leaf tissue, causing shot-holes that render the leaves unmarketable.

Investigations on the bionomics and control of this Mirid were carried out in 1937–44. The bugs were reared in the laboratory with fresh, tender betel leaves for food and tender pieces of stem for oviposition. The eggs are laid singly in the stems. The average number of eggs per female varied in different

months from 18 to 72, and the preoviposition and oviposition periods from about 6 to 10 and 5 to 22 days. The eggs hatched in 8–16 days and the nymphs matured in 12–18. Warm, humid weather during June–October favours multiplication, while activity is least in December–January.

The results of experiments with insecticides against the adults and nymphs are given in tables. Of several tested in 1940 and 1941, a spray of tobacco waste (1 : 20) was the cheapest and was at least as effective as any of the others, which were therefore discarded. In 1943 and 1944, one or two applications of tobacco waste at 1 : 15 or two or three at 1 : 20 reduced the damage to the leaves by 90 per cent. or more. Since there was no significant difference between these treatments, the smaller number of sprays of the higher concentration is preferable. The crop should be sprayed when the damage exceeds 5 per cent., successive applications being made at intervals of about two weeks.

JENKINS (C. F. H.) & FORTE (P. N.). **The Lucerne Flea** (*Sminthurus viridis*, **L.**). —*J. Dep. Agric. W. Aust.* (2) **25** no. 2 pp. 116–120, 4 figs. Perth, W.A., 1948.

Notes are given on the appearance and bionomics of *Smynthurus viridis*, L. [*cf. R.A.E.*, A **28** 564, etc.], which is widely distributed in Western Australia where it damages subterranean clover [*Trifolium subterraneum*] and lucerne, and sometimes attacks vegetable crops, with recommendations for its control. The predacious Bdellid mite, *Biscirus lapidarius*, Kramer, affords some control in permanent pasture and its rate of spread can be accelerated by distributing mites from active colonies over the fields. Cultural measures comprise sowing clover or lucerne on clean fallow and sowing lucerne in spring, to enable the plants to become established during summer, when populations of *Smynthurus* are low. Spraying with lime-sulphur (1 : 60) is effective in assisting lucerne to become established and on other special areas. In preliminary tests in 1947, 4 per cent. DDT mixed with superphosphate applied to pasture at rates of 2 cwt. per acre (equivalent to 4·25 lb. p,p′ DDT per acre) gave disappointing results, but 4 per cent. benzene hexachloride mixed with superphosphate and applied at the same rate (equivalent to 1·165 lb. γ isomer per acre) showed promise.

MAY (A. W. S.) & FISHER-WEBSTER (K.). **Codling Moth Control Experiments, 1947–48.**—*Qd agric. J.* **67** pt. 3 pp. 143–146. Brisbane, 1948.

Experiments with DDT sprays against the codling moth [*Cydia pomonella*, L.] on apple in Queensland [*cf. R.A.E.*, A **36** 180] were continued in 1947–48. The trees, which were of a late-maturing variety, received, in most cases, a calyx and six cover sprays. The first and second cover sprays were timed by bait-trap records, and the subsequent sprays were applied at intervals of three weeks. The DDT sprays contained 0·1 per cent. DDT and were prepared, except where otherwise stated, from a dispersible powder, and a complete schedule of sprays of lead arsenate with the addition of lime to reduce foliage injury and zinc sulphate to improve control [*cf. loc. cit.*] was used for comparison. The percentages of fruits injured at harvest (including superficially injured as well as infested ones) were 20·2 for a complete DDT schedule preceded by a semi-dormant spray of pale oil and lime-sulphur, 18·1 and 17·6 for a DDT schedule with the addition of hexaethyl tetraphosphate (1 : 1,600) and wettable sulphur, respectively, in the first, third and fifth cover sprays (for the control of *Bryobia praetiosa*, Koch), 17·6 for a DDT schedule from which the calyx spray was omitted, 18·6 when lead arsenate replaced DDT in the calyx spray, 7·6 for a similar schedule in which the DDT sprays were prepared from an emulsion concentrate, 20·1 for the lead-arsenate schedule, 68·5 for a calyx spray of lead

arsenate with no cover sprays, and 73·3 for no treatment. The addition of hydrated lime to lead arsenate greatly reduced the amount of foliage injury, although varying degrees of scorching were observed on all trees that received this schedule. The inclusion of the lime and zinc sulphate also greatly increased the problem of spray residues [*cf. loc. cit.*]. All the DDT schedules gave effective control of *C. pomonella*; there was no noticeable spray residue or foliage injury and the fruits were clean and attractive. No conclusion could be reached regarding the value of a calyx spray in DDT schedules, but its inclusion is less important in a programme of DDT than in one of lead arsenate because of the greater efficiency of DDT during the period of fruit development.

Only small infestations of the woolly Aphid [*Eriosoma lanigerum*, Hsm.] developed on the experimental trees, and the parasite, *Aphelinus mali*, Hald., which was present in varying numbers throughout the season, had destroyed most of the Aphids by the end of the growing period. Observations throughout the summer and autumn indicated that hexaethyl tetraphosphate, at the concentration used, showed little promise of replacing nicotine sulphate for the control of this Aphid. Only slight foliage injury was caused by *Bryobia*. The use of pale oil and lime-sulphur at bud-burst proved far more effective against this mite than wettable sulphur or hexaethyl tetraphosphate during the summer, and it appears that control of *Bryobia* should be undertaken before the onset of conditions favourable to its development.

Annand (P. N.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, 19[44–]45.**—63 pp. Washington, D.C., U.S. Dep. Agric., 1946. **Report . . . 19[45–]46.**—63 pp., 1 map, 1 fig. 1947.

These two reports contain accounts of work on insect pests and their control in the United States during the years ended 30th June 1945 and 1946, respectively, some of which has already been noticed. Much of the work recorded in the first, particularly on insecticides, was preliminary to that in the second, and the information here noticed is from the latter unless otherwise stated.

Extensive tests on the application of insecticides from aeroplanes are described in the first report. The results obtained in Washington and Oregon when dust mixtures containing DDT or rotenone were applied against the pea Bruchid [*Bruchus pisorum*, L.] and the pea Aphid [*Macrosiphum onobrychis*, Boy.] were as good as those obtained from the ground, satisfactory results were obtained when DDT dusts were used against *Lygus* and the beet leafhopper [*Eutettix tenellus*, Baker] on sugar beets grown for seed in Arizona, and hornworms [*Protoparce*] and flea-beetles on tobacco were successfully controlled with cryolite dusts in North Carolina, but a rotenone dust was less effective against the Mexican bean beetle [*Epilachna varivestis*, Muls.] on beans in the latter State when applied from the air than when applied from ground machines, since it failed to reach the larvae on the lower surfaces of the leaves. When a cryolite dust was applied from an aeroplane in Washington against potato flea-beetles, the insecticide was distributed mainly on the tops of the plants and the populations were not reduced so much as when the dust was applied from the ground.

DDT gave outstanding results in sprays against the codling moth [*Cydia pomonella*, L.] on apple in both 1944 and 1945, but has not been given unqualified recommendation, owing to its tendency to cause outbreaks of mites and to uncertainty as to residues. In preliminary tests, concentrated solutions of DDT atomised and blown into the trees were less effective than ordinary sprays and caused some injury. In Ohio, a single application of DDT to peach trees 20 days before harvest significantly reduced late-season injury by the oriental

fruit moth [*Cydia molesta*, Busck] and the residues at harvest were well under 7 parts per million. Unfortunately, DDT is highly toxic to *Macrocentrus ancylivorus*, Rohw., the important parasite of this moth [*cf. R.A.E.*, A **36** 258]. When a solution of DDT in xylene and kerosene at 1 lb. per U.S. gal. was applied to shade trees and ornamental plants as a fine mist with a power blower at the rate of 1 U.S. gal. per acre, it destroyed a heavy infestation of the Japanese beetle [*Popillia japonica*, Newm.] and prevented reinfestation. Sprays of DDT micronised on fuller's earth gave higher control of the European corn borer [*Pyrausta nubilalis*, Hb.] than any other material tested.

DDT was extensively tested in 1945 against various pests of cotton. In Louisiana, dusts containing 5 and 10 per cent. DDT were more effective against the tarnished plant bug [*Lygus oblineatus*, Say] and the rapid plant bug [*Adelphocoris rapidus*, Say] than calcium arsenate or mixtures of calcium arsenate and 2·5 per cent. DDT, but DDT was much less effective than calcium arsenate against the boll weevil [*Anthonomus grandis*, Boh.]. In Texas, DDT in atomised oil sprays and in xylene emulsions killed bollworms [*Heliothis armigera*, Hb.] more quickly than a DDT dust, and dusts containing 5 and 10 per cent. DDT were more effective than a dust of cryolite and sulphur. Mixtures of DDT and sulphur gave outstanding control of the fleahopper [*Psallus seriatus*, Reut.], and a 5 per cent. DDT dust gave excellent control of this Mirid in 1946. Cotton Aphids [*Aphis gossypii*, Glov.] increased more when a mixture of DDT and calcium arsenate was applied than when either material was used alone, but the addition of 1 per cent. nicotine prevented an increase. In tests to find an inexpensive spray carrier for DDT that would not injure cotton plants when applied at the rate of 3–9 U.S. gals. per acre, the most satisfactory combination developed consisted of DDT dissolved in xylene with a small quantity of Triton X-100 (an aralkyl polyether alcohol) or Igepal CA (condensation product of ethylene oxide and an alkylated cresol) as an emulsifier. Applications of 7·5–15 lb. DDT per acre in sprays or dusts reduced populations of the pink bollworm [*Platyedra gossypiella*, Saund.] by 65–95 per cent., the degree of control increasing with the amount of DDT, but DDT did not control red spiders [*Tetranychus*] and Aphids on cotton in the Presidio Valley, though populations did not increase sufficiently after nine applications to necessitate control measures. Chemical investigations indicated that technical and pure DDT either undiluted or mixed with inert powders undergo very little decomposition when exposed to ultra-violet light and sunlight. When DDT dissolved in an organic solvent is irradiated, however, the decomposition is greater, the degree depending upon the solvent used. A study of possible absorption of DDT from soil into the tissue of plants did not reveal significant amounts of DDT in the plants in any case.

Benzene hexachloride was tested against various insects. In tests in Louisiana, it was found to have both fumigant and contact action against *Anthonomus grandis* and *L. oblineatus* on cotton and was more effective than DDT against both insects, although calcium arsenate gave the highest mortality of the weevil. In South Carolina, benzene hexachloride (10 per cent. γ isomer) gave complete control of thrips on cotton in 24 hours and reduced the numbers of red spiders by 96 per cent. in 12 days. It had to come in contact with the red spiders to be effective. It injured the young terminal growth of cotton in the greenhouse and cotton in the pre-square stage in the field but the injury was soon outgrown and there was little if any economic loss. Benzene hexachloride gave promising results in the laboratory in Maryland against *C. pomonella*, but in Indiana it was less effective than DDT, failed to control orchard mites and seriously affected the taste of apples harvested three weeks after application. It was less effective than DDT against the pear thrips [*Taeniothrips inconsequens*, Uzel] and less effective than nicotine against the pear psylla [*Psylla pyricola*, Först.]. Very small quantities were highly toxic

to larvae of *Popillia japonica* in the soil, and encouraging results were obtained against the plum curculio [*Conotrachelus nenuphar*, Hbst.].

Investigations in Louisiana showed that the parasites, *Triaspis vestiticida*, Vier., and *Bracon* (*Microbracon*) *vestiticida*, Vier., which were imported from Peru and released in cotton fields in Texas and Louisiana, would oviposit on larvae of *Anthonomus grandis* in cotton squares and complete their development in them. Both were reared from squares collected in the field after releases were made, but there is no evidence that these parasites have survived the winter.

The extensive infestation by the spruce budworm [*Harmologa fumiferana*, Clem.] in Colorado [*cf.* **34** 176] decreased suddenly in 1945–46, apparently owing to the action of parasites, which became very numerous. Since three of the species observed, including *Ceromasia auricaudata*, Tns., which was abundant, do not occur in the north-eastern United States, larvae parasitised by them were collected for release there. The outbreak of the Engelmann spruce beetle [*Dendroctonus engelmanni*, Hopk.] in Colorado [*cf.* **34** 176] continued unabated in both years. It is stated in the earlier report that the beetles hibernate beneath the bark at the base of the trees during the second winter, and this may be important for control. An extensive outbreak of the mountain pine beetle [*D. monticolae*, Hopk.] occurred on pine in Idaho and Wyoming. Following the outbreaks of *Ips confusus*, Lec., near the sites of logging operations in California during 1944 and 1945, investigations were begun on the extent to which untreated slash favours the multiplication of the beetles. When green slash was sprayed with 5 per cent. DDT in kerosene, fresh attacks were practically eliminated and complete control of the larvae already present and over 90 per cent. control of pupae and recently emerged adults resulted. More than 125 square miles in Pennsylvania, New York and New England were sprayed with DDT against the gipsy moth [*Lymantria dispar*, L.]. Applications made from aircraft or by means of a new type of blower gave complete control and treatment with knapsack sprayers very considerable reductions [*cf.* **36** 36].

Marked progress has been made in the development of mist blowers for applying concentrated sprays from the ground. Finely atomised sprays can be effectively blown vertically up to 100 ft. and horizontally over 600 ft., and nozzles have been developed that will disperse most insecticides and fungicides as solutions, emulsions or suspensions. Solutions of nicotine alkaloid in kerosene applied by this method killed 92–96 per cent. of adults of *Psylla pyricola* on pear. Nicotine sulphate in a concentrated water solution and concentrated sprays of DDT, pyrethrum or benzene hexachloride were less effective than the alkaloid. The use of flame cultivators by cotton growers is increasing, and an attachment has been devised to feed liquid insecticides to the burners for volatilisation against cotton insects. By manipulating the valves it is possible to apply the insecticides at any desired rate.

It is stated in the first report that wrappings coated or impregnated with DDT, an acrylamide or a trichlorbutyramide prevented insects from entering packages of cereals, and that preliminary tests indicated that packing-line fumigants for use on dried fruit are more effective when applied to the top of the fruit in the filled boxes than when applied to the bottom of the empty boxes, as is done at present. A mixture of equal parts of acrylonitrile (vinyl cyanide) and carbon tetrachloride killed all larvae of the raisin moth [*Ephestia figulilella*, Gregson] and adults of the saw-toothed grain beetle [*Oryzaephilus surinamensis*, L.] at 4 oz. per 1,000 cu. ft. with an exposure of 15 hours at 68–82°F. At a lower temperature, a dosage of 2 ml. of this mixture killed all test insects and eggs in solid-fibre 25-lb. boxes of raisins with a capacity of 0·41 cu. ft.; no hydrocyanic acid was found in raisins exposed to acrylonitrile. It is stated in the second report that DDT, applied as a solution, emulsified solution or

suspension, was found to be the most effective material for treating the interior walls of wooden farm granaries to reduce insect infestation. In tests of grain fumigants, 5 per cent. ethylene dibromide in various combinations with carbon tetrachloride, ethylene dichloride and carbon bisulphide protected wheat in steel bins and wooden granaries from infestation at rates of 2–3 U.S. gals. per 1,000 bushels. A mixture of acrylonitrile and carbon tetrachloride (14 : 86) at 2 U.S. gals. per 1,000 bushels gave excellent results in wheat in wooden granaries. A heavy infestation of grain insects found in farm bins two years previously was reduced to a negligible amount and reinfestation prevented by fumigating once a year in August with a mixture of ethylene dichloride and carbon tetrachloride (3 : 1) at 6 U.S. gals. per 1,000 bushels.

Ethylene dibromide proved much more effective than ethylene dichloride for dipping soil masses and plant balls against eggs, larvae and pupae of *Popillia japonica* and for surface application to plots containing larvae and pupae. It also showed promise as a fumigant against the adults. Authority was granted on 21st March 1946 for the use of DDT for treating soil in nursery plots and potting soil against *Popillia japonica* to obtain certification of plants grown in such soil. Plots with or without growing plants can be treated. The rate is 25 lb. technical DDT per acre, and it is thought that this treatment will eventually supersede the previously required treatment with lead arsenate at 1,000 lb. per acre. In investigations on the tolerance of nursery plants to fumigation with methyl bromide for the control of white-fringed beetles [*Graphognathus*], it was found that injury from this fumigant was inversely related to the rate of transpiration of the plants during the six hours following treatment. By regulating the factors governing transpiration, the risk of injury was reduced. Fumigation with methyl bromide applied as a gas or injected as a liquid either undiluted or in an organic solvent was found to kill larvae of *Platyedra gossypiella* in bulk cotton seed and other products in all portions of the load at rates that did not reduce the germinating quality of the seed.

Work has been proceeding since 1942 on the prevention of injury by clothes moths to large amounts of imported wool stored under government supervision. It is stored in compressed bales, and 500,000 of these were sprayed with DDT in 1945. Only 6–10 per cent. of the total bale surface could be treated, and the DDT was applied in the form of oil solutions and water-dispersible sprays containing 1 and 0·25 per cent. DDT at the rate of about 1 U.S. gal. per 10 sq. ft. of surface. The treatments were completed early in the summer, and from then until autumn very few living adults were found, though there were thousands of dead ones on the floor. There was little difference in effectiveness between the solution and the water-dispersible DDT, but the stronger spray was the more effective in each case. The results were so favourable that the method was adopted commercially.

It is stated in the first report that investigations on the structure of the pyrethrins showed that the so-called pyrethrolone, the alcoholic portion of the pyrethrin esters, is made up of a major component for which the name pyrethrolone is retained and a considerable proportion of a second compound called cinerolone, which contains one less carbon atom in the side chain of the molecule. Pyrethrins I and II and cinerins I and II were prepared from both optically active and racemic pyrethrolone and cinerolone. During the second year, partial synthesis of the pyrethrins and cinerins was carried out and total synthesis of the cinerins partly completed. In tests against house-flies [*Musca domestica*, L.], pyrethrin I, cinerin I and pyrethrin II were about 6, 4 and 1½ times as toxic, respectively, as cinerin II.

Infestation of apple by the Comstock mealybug [*Pseudococcus comstocki*, Kuw.] was low in Virginia in 1945. The mealybug remained scarce in Ohio and New Jersey but was moderately abundant in some orchards in Delaware and Connecticut. Parasitism increased steadily during the summer in spite of

the decline in population. *Allotropa burrelli*, Mues., was the dominant parasite in Virginia, but *Pseudaphycus* sp. was the most abundant elsewhere.

In tests in Mississippi recorded in the first report, copper naphthenate in Stoddard's solvent (1 per cent. metallic copper based on weight of goods) combined with 15 per cent. creosote gave the best protection to cloth exposed to subterranean termites. Such a treatment would be suitable for sandbags and other fabrics used in military operations. Copper pentachlorphenate (1 per cent. metallic copper) dissolved in ethylene glycol monobutyl ether (butyl cellosolve) protected treated fabric against subterranean termites and decay for seven months. Copper naphthenate in kerosene (2 per cent. metallic copper) afforded protection for several months to pine ammunition-box lumber that was dipped in it for three minutes and then dried. Copper pentachlorphenate in methyl alcohol (0·5 per cent. metallic copper) gave little protection to wood ; methyl alcohol proved to be a poor solvent for this compound.

Insects recorded in the United States for the first time in the first report include *Lineodes vulnifica*, Dyar, a Mexican and Central American Pyralid, on peppers [*Capsicum*], and *Moodna bisinuella*, Hmps., another Mexican Pyralid, in the stalks and ears of green maize, both in Texas.

Importations of beneficial insects were continued in both years [*cf.* **34** 179]. Large consignments of *Chrysomela* (*Chrysolina*) *hyperici*, Forst., *Chrysomela quadrigemina*, Suffr. (*Chrysolina gemellata*, Rossi) and *Agrilus hyperici*, Crtz., were received from Australia for testing against Klamath weed [*Hypericum perforatum*] in California, and the first two were released in the field [*cf.* **36** 188]. Methods were developed in the second year for breaking the diapause of these two species, and it was found that no feeding or reproduction occurred on cotton, tobacco, sweet potato, flax, hemp or sugar-beet. In that year, *Enicospilus merdarius*, Grav., and *Apanteles* sp. were introduced from Uruguay and *Calosoma argentinense*, Csiki, from Argentina against armyworms [*Cirphis unipuncta*, Haw.] in Florida. Consignments of *Theresia claripalpis*, Wulp (*Paratheresia diatraeae*, Brèth.), *Parthenoleskia parkeri*, Tns., *Apanteles* sp. and *Ipobracon* sp. were shipped to Porto Rico for use against the sugar-cane borer [*Diatraea saccharalis*, F.]. A survey of the principal lime-growing district in the State of Colima, Mexico, showed that *Eretmocerus serius*, Silv., which was introduced in 1943 [*cf.* **34** 179], has not controlled the citrus blackfly [*Aleurocanthus woglumi*, Ashby].

Service and Regulatory Announcements, July–September 1947. — *S.R.A., B.E.P.Q.* no. 169 pp. 59–109. [Washington, D.C.] U.S. Dep. Agric., 1948.

The distribution of the Dutch elm disease, which is caused by *Ceratostomella ulmi* [and transmitted chiefly by Scolytids], in the United States is limited to the Ohio River valley and certain States north of Virginia. It has recently been found in the Province of Quebec, Canada [*cf. R.A.E.*, A **36** 163], and since elm logs are imported into the mid-western United States each year from Canada chiefly for use in the manufacture of veneer, Quarantine No. 70, which is designed to prevent the entry of elm wood containing the fungus, is revised. The provisions relating to Europe are unchanged [*cf.* **23** 271], but the quarantine is extended to include Canada and other foreign areas north of the United States, including Newfoundland, Labrador, the islands of St. Pierre and Miquelon and other neighbouring islands. The importation from the Province of Quebec of living plants or parts of plants, logs, and lumber, timber and veneer bearing bark of elm or related plants and of containers or other articles made wholly or in part of wood of these plants from which the bark has not been entirely removed is prohibited. Logs, lumber and other parts incapable of propagation originating elsewhere in the designated northern areas may be imported under permit and notice of arrival or if accompanied by a certificate

of origin. Clean seed from any of the designated northern areas and other propagative material from any except the Province of Quebec may be imported subject only to the provisions of the Nursery Stock, Plant and Seed Quarantine (No. 37). The entry of material for experimental and scientific purposes may be authorised under such conditions as may be prescribed.

Announcements relating to Quarantine No. 52 against the pink bollworm [*Platyedra gossypiella*, Saund.] remove south-western Louisiana from the quarantined area, since no further infestation has been found there following the application of eradication measures against the heavy infestations discovered in 1943 [**33** 111], and makes slight changes in the regulated area in Texas.

An Amendment to the Plant Quarantine Act [**17** 163] authorises further regulation of the entry of nursery stock from foreign countries.

Other information includes revised digests of plant-quarantine import restrictions in Argentina and South Africa, supplements to restrictions already noticed in Great Britain [**28** 611], Guatemala [**26** 134] and Venezuela [**36** 105] and a revised supplement to restrictions already noticed in Cuba [**36** 105].

Stoa (T. E.). **Rescue Wheat.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **10** no. 2 pp. 43–45. Fargo, N. Dak., 1947.

A variety of beardless hard red spring wheat known as Rescue has been developed in Saskatchewan for resistance to the sawfly [*Cephus cinctus*, Nort.]. Females apparently deposit their eggs as freely on it as on other varieties, but many of the young larvae die before reaching the base of the pithy stem, where they overwinter. As a result, very few of the stems are cut and break over, and harvesting is therefore easy and efficient. Tests of the yield under conditions in north-western North Dakota were carried out in three localities in 1945–47, when Rescue was compared with five other varieties. All the grain was harvested as soon as mature and before there was much stem-breaking. The results showed that Rescue gave a somewhat lower yield than the other varieties when damage by the sawfly was not severe. It also possesses less desirable milling and baking qualities, and it was concluded that it is suitable for use chiefly as an emergency variety when spring wheat has to be grown where there is danger of heavy sawfly infestation and harvesting facilities are inadequate [*cf. R.A.E.*, A **34** 146].

Munro (J. A.), Post (R. L.) & Knapp (R.). **The Wheat Stem Sawfly as affecting Yield.**—*Bi-m. Bull. N. Dak. agric. Exp. Sta.* **10** no. 2 pp. 46–51, 3 figs., 1 ref. Fargo, N. Dak., 1947.

An annual loss of wheat estimated at more than three million bushels has for many years been sustained in North Dakota, mainly in the north-western counties, owing to attack by *Cephus cinctus*, Nort. These losses, which are chiefly to hard spring varieties, are usually attributed to the breaking of infested stems, which results in the loss of many heads of grain at harvest [*cf. R.A.E.*, A **34** 146], but investigations in 1947 indicated that infestation itself reduced the yield. The results, which are tabulated, showed that 61·5 per cent. of the more vigorous, primary stems were attacked as compared with 29·1 per cent. of the secondary stems, and that the yields from uninfested primary and secondary stems (as weight per 100 heads) exceeded those of infested ones by 9·1 and 2·8 per cent., respectively. The weight per 1,000 kernels was 5·6 and 2·3 per cent. greater for uninfested primary and secondary stems, respectively, than for infested ones. The similarity in yields of infested and uninfested stems in a previous experiment [*loc. cit.*] can be explained by the tendency of the sawfly to infest the more vigorous stems and reduce their yield to that of the less vigorous, uninfested ones.

Further evidence of the importance of prompt harvesting in minimising losses due to mechanical injury by the larvae [*cf. loc. cit.*] was obtained in the same year, when one of two fields of wheat that had been treated in an identical manner was harvested in the second week of August and the other in the first week of September. The percentage loss of wheat (in bushels per acre) due to infestation was 0·84 for the first and 2·23 for the second ; the slight variation in the degree of infestation in the two fields was probably not significant.

CROMBIE (A. C.). **Further Experiments on Insect Competition.**—*Proc. roy. Soc.* (B) **133** no. 870 pp. 76–109, 10 figs., 55 refs. London, 1946.

The following is the author's summary. The growth of populations of the beetles, *Tribolium confusum*, Duv., and *Oryzaephilus surinamensis*, L., was observed in media of wheat, coarse wholemeal flour and fine wholemeal flour, respectively. These were maintained at a constant level by the periodic transference of the insects to equal amounts of fresh media. Population growth was best observed in fine flour, from which all stages could be sifted out and counted. In populations of each species beginning with two adult males and two females, maxima for eggs, larvae and pupae succeeded each other and finally adults emerged and themselves rapidly rose to a maximum. The adult populations remained steady at the maximum, while egg, larval and pupal populations fluctuated round mean values. The rate of population growth was determined by the rates of oviposition and development on the one hand, and of cannibalism on the other. Such cannibalistic eating of eggs and, more important, of pupae by adults and larvae, rather than the limitation of food, also determined the maximum population size. A comparison of the rates of oviposition with the rates at which adults emerged showed that in such populations the mortality in the immature stages was over 99 per cent.

In competition with *Oryzaephilus*, which depended entirely upon mutual predation, *Tribolium* had the advantage because of its greater voracity [*R.A.E.*, A **32** 323]. *Oryzaephilus* was driven out of the flour media which did not protect its pupae. But when the flour media contained glass tubing of such bore as to allow its larvae to enter it and pupate, but to exclude *Tribolium* adults and large larvae, *Oryzaephilus* survived together with *Tribolium* just as it did in wheat. In wheat, the beetle *Rhizopertha dominica*, F., survived together with *Tribolium*. The three species, *Rhizopertha*, *Tribolium* and *Oryzaephilus*, also survived together in this medium. The results of these competitions support the contention that species with the same needs and habits are unable to survive together in the same environment while species which differ in needs or habits may do so [**32** 315 ; **34** 97].

The position at which equilibrium between any two of the competing species was reached was independent of the initial density of each species. When constants of the Lotka-Volterra simultaneous equations for the population growth of two species competing for the same limited environment were calculated from the experimental data, they led to inequalities corresponding to definite equilibrium positions for these equations. The actual equilibrium positions reached by the populations were in every experiment the same as those reached by the equations. The biological assumptions on which these equations are based are not, however, strictly true for *Tribolium* and *Oryzaephilus*.

Populations living in unrenewed flour rose to a maximum and then declined as the food became exhausted and " conditioning " increased. As time passed, the age composition shifted from a majority of young stages to a majority of adults. The extinction of the *Tribolium* population was due to the failure of the larvae to develop and pupate, and of the *Oryzaephilus* population to this as well as to the cessation of oviposition. The adults, having failed to reproduce themselves, eventually died.

Wigglesworth (V. B.). **The Epicuticle in an Insect,** *Rhodnius prolixus* **(Hemiptera).**—*Proc. roy. Soc.* (B) **134** no. 875 pp. 163–181, 7 figs., 25 refs. London, 1947.

The following is the author's summary of investigations on the epicuticle of *Rhodnius prolixus*, Stål. The "epicuticle" in *Rhodnius* consists of four layers [*cf. R.A.E.*, A **37** 43]. From within outwards these are: (i) the "cuticulin" layer, composed, it is suggested, of polymerised lipoproteins tanned by quinones [*cf.* **35** 202–203; **37** 39]; (ii) the "polyphenol layer", rich in dihydroxyphenols; (iii) the "wax layer" responsible for the waterproofing of the cuticle; (iv) the "cement layer" of unknown nature protecting the wax [**34** 60]. The pore canals appear to penetrate the cuticulin layer.

The oenocytes produce the lipoproteins which are deposited by the epidermal cells to form the cuticulin layer. The polyphenols then appear at the tips of the pore canals as minute droplets which unite to form a continuous film over the surface of the cuticulin. The wax is then secreted, also by the epidermal cells, and laid down over the polyphenol layer immediately before the old skin is shed. The cement is secreted by the dermal glands and poured out over the surface of the wax within an hour after moulting.

The storage and use of the reserves of glycogen, fat and protein during the moulting process are described.

Beament (J. W. L.). **The waterproofing Process in Eggs of** *Rhodnius prolixus* **Stähl.**—*Proc. roy. Soc.* (B) **133** no. 873 pp. 407–418, 2 figs., 15 refs. London, 1946.

The following is the author's summary. The seven layers of the chorion covering the egg of the bug, *Rhodnius prolixus*, Stål, are all freely permeable to water. The egg has no active physiological mechanism preventing desiccation, and is waterproofed by a layer of wax, less than 0·5μ thick, which covers the inside of the chorion. The wax is similar to that which waterproofs the cuticles of most adult forms of insect, and shows a typical transition point in its water-loss/temperature curve at 42·5°C. [108·5°F.]. The waterproofing wax layer is secreted by the maturing oocyte, and is securely attached to the innermost layer of the chorion. The secretion of the wax takes place in the ovary, either just before or after the egg is released from its follicle, but a wax layer can be obtained by incubation of eggs with incomplete chorions. The layer of wax is complete across the inner openings of the micropylar tubes; it is supported at these points on the vitelline membrane before fertilisation, and on the fertilisation membrane after this has been formed.

Beament (J. W. L.). **The Penetration of the Insect Egg-shells. I.—Penetration of the Chorion of** *Rhodnius prolixus*, **Stål.**—*Bull. ent. Res.* **39** pt. 3 pp. 359–383, 12 figs., 19 refs. London, 1948.

The following is the author's summary of investigations on the mode of entry of liquids that penetrate the chorion of eggs of *Rhodnius prolixus*, Stål. The unspecialised portion of the shell and the cap of *Rhodnius* eggs are impermeable to almost all hydrophilic and lipophilic liquids. If water and very small ions pass through the chorion, they must traverse a wax layer on the inside of the shell [*cf.* preceding abstract]. Certain corrosive materials, *e.g.*, glacial formic acid, may pass through the shell slowly. These conclusions, based on experiments with pieces of shell, have been confirmed in ovicidal experiments. A range of materials with widely differing properties enter the embryo only through the micropyles, of which there are approximately 15 in the rim of each shell. At least one micropyle must be traversed to kill an egg, but many eggs were

killed when only one had been penetrated. A cement, applied by the female at oviposition, may occlude the outer orifice of a micropyle. The properties of the cement are described ; it appears to be a tanned protein. Cement deposits are much more copious on the eggs laid by younger females. Such eggs are more resistant to ovicides because penetration is delayed. This increased resistance is more pronounced when oleophilic liquids are used owing to the rapidity with which they kill eggs from older females. The random distribution of cement is one cause of the variability of replicates in ovicidal tests.

A detailed investigation has been made of factors governing liquids traversing the micropyles. Hydrophilic liquids invade the outer lipophilic part of the micropyle slowly ; the displacement of air is the most important factor and small changes in the wetting power of the liquid make little difference to the rate of entry. Aqueous liquids are absorbed into the protein lining of the inner portion of the micropyle. They reach the wax layer on the inside of the shell by migrating into and through the inner protein layer. The area which is invaded increases linearly with time. Mortality, therefore, increases as the square of the time of immersion, but it is proportional to the increase in concentration of a solute if the period of immersion is constant. Oleophilic liquids wet the micropyle actively. They may by-pass air and flow rapidly to the wax at the inner end of the tube. Wax solvents kill very quickly and are much more toxic than other lipophiles. Water in the micropyle and shell may affect the entrance of either type of liquid. In general, it increases the toxicity of aqueous solutions and retards the entry of oils. Wax-emulsifying materials added to aqueous solutions do not produce great increases in toxicity. They are " filtered out " at the protein lining of the micropyle and do not reach the wax layer for a considerable period of time.

NOTLEY (F. B.). **The *Leucoptera* Leaf Miners of Coffee on Kilimanjaro. I.—*Leucoptera coffeella*, Guér.**—*Bull. ent. Res.* **39** pt. 3 pp. 399–416, 10 figs., 7 refs. London, 1948.

The author presents the results of his own investigations on the fluctuations in the populations of *Leucoptera coffeella*, Guér., and its parasites on coffee in the Kilimanjaro area of Tanganyika Territory in 1937–40, some of which have already been noticed [*R.A.E.*, A **29** 175 ; **30** 506], and also information on the bionomics of both host and parasites at Amani, supplied by T. W. Kirkpatrick. The development of *L. coffeella* there lasted rather more than 45 days at 19°C. [66·2°F.] and rather more than 25 at 25°C.[77°F.] ; the corresponding periods for *L. caffeina*, Washbn., were about 40 and less than 25 days, respectively. Eggs of *L. coffeella* were laid singly or in small groups and almost invariably on the upper surface of the leaf. An average of 75 eggs per female were laid over an average period of 13·4 days, and 78 per cent. of the eggs were deposited within eight days of emergence. The pre- and post-oviposition periods averaged 2·1 and 4·5 days, respectively. The few unfertilised eggs laid were not viable. The proportion of females that oviposited on only a few nights or not at all was increased for examples that had developed under drier conditions and at a greater range of diurnal temperatures than prevailed at Amani. The larvae mine separately in the leaves for 2–4 days, after which they form a common mine. They pupate in cocoons on the lower surface of the leaves after a prepupal stage of 30–36 hours. In the laboratory, adults emerged from 97–98 per cent. of the cocoons ; mortality was high among prepupae on robusta coffee. Field studies indicate that about 50 per cent. parasitism is sufficient to maintain a balance between host and parasites.

In general, parasitism in both shaded and unshaded coffee in the Kilimanjaro area remained very low between May and October and became heavy after

November. Some ten primary and secondary parasites were reared from larvae on unshaded coffee; the most important were *Atoposoma variegatum* var. *afrum*, Silv., and *Apanteles bordagei*, Giard (subsequently referred to as *Atoposoma* and *Apanteles*). Nine parasites, including some that attack the larvae, were reared from field-collected cocoons, and of these the Braconid near *Hormius* and *Pleurotropis coffeicola*, Ferrière, were the most important. Parasitism was at a maximum towards the end of the year, and the Braconid was responsible for nearly 50 per cent. at the end of 1939 and 1940 and for 70 per cent. in late 1938 and early 1939. Later in the season, it was replaced by *P. coffeicola*, which was obtained from about 50 per cent. of the cocoons in May 1939 and March 1940. The Braconid chiefly attacks the prepupae and pupae, and its decline in importance coincided with the suppression of the larvae by *Atoposoma*. *P. coffeicola* attacks the larvae in their mines and also attacks other parasites such as *Apanteles* and the Braconid near *Hormius*, and so is better able to survive. On shaded coffee the numbers of eggs of *L. coffeella* fluctuated less than on unshaded, but showed the same tendency to increase towards the end of the year. *Apanteles* was the only consistently important parasite of the larvae, and its numbers closely followed those of its host. Ten other parasites were reared from larvae collected on shaded coffee, including *P. coffeicola*, which occurred in small numbers throughout the observation period, *Ageniaspis* sp., which was sporadically common, but otherwise rare, and *Atoposoma*, which was very rare. *L. caffeina* is more numerous on shaded coffee than *L. coffeella* and difficulty was experienced in separating the cocoons of the two species. It was found, however, that a large proportion of the cocoons on leaves on the trees were those of *L. coffeella*, whereas cocoons on leaves on the ground were almost entirely those of *L. caffeina*. Only five important parasites were reared from cocoons collected from the trees. Of these, *Apanteles* was always and *Eulophus borboricus*, Giard, usually present, *Ageniaspis* sp. was of considerable importance, expecially when the others were scarce, and *Pleurotropis coffeicola* was always more important than the Braconid near *Hormius*. Four others were occasionally obtained.

Notes, based largely on work at Amani [*cf.* **28** 144], are given on the bionomics of 14 parasites, comprising 13 recorded in the Kilimanjaro area and a species of *Eulophus* that does not occur there but is so effective at Amani that attempts are being made to introduce it. It is a primary ectoparasite on the larvae of both *L. coffeella* and *L. caffeina* and may be secondary if its host is already attacked by an endoparasite. The females usually sting all the larvae present in a mine, but fully fed ones are preferred for oviposition. The first parasite larva to hatch feeds on any parasite eggs present, and the larvae attacked one another. One host larva is sufficient for development, though three or more may be sucked. The life-cycle lasts 12–27 days, and females have survived for up to 77 days. It is parasitised by *Pleurotropis coffeicola*, *Closterocerus africanus*, Wtstn., *Teleopterus violaceus*, Ferrière, *Achrysocharella* sp., *Achrysocharis* sp., *Cirrospilus cinctiventris*, Ferrière, and *Tetrastichus* (*Tetrastichodes*) *leucopterae*, Ferrière. *Atoposoma* is also ectoparasitic on the larvae of both species of *Leucoptera*, but does not always attack all the larvae present in a mine. The eggs are deposited loose in the mine and there may be up to five per host larva, one of which can support three parasites. The life-cycle lasts 13–29 days, and the adults survive for up to 90 days and oviposit up to 61 days. Unfertilised females oviposit readily, giving rise to males, and females comprise 62 per cent. of the progeny of fertilised females. It is parasitised by *P. coffeicola*, *Closterocerus africanus* and *Teleopterus violaceus*. The endoparasitic Braconid near *Hormius* attacks the older larvae of both species in the mines, as well as the prepupae and pupae in their cocoons, but hosts already parasitised by *Apanteles* are apparently rejected. The life-cycle lasts 13–16 days, and pupation occurs in the host cocoon. Unfertilised females give rise to males only. *Apanteles*,

which is a primary endoparasite of *L. coffeella*, is normally parthenogenetic. It attacks the host larvae in the mines and pupates within their cocoons. The life-cycle lasts 14–25 days or more. *Pleurotropis coffeicola*, which is a primary and secondary endoparasite of both species of *Leucoptera*, is common as a primary parasite on robusta coffee but not on arabica coffee at Amani. Its life-cycle lasts 18–38 days, the adults survive for up to 58 days, and oviposition continues for 48. This species is a secondary parasite on *Eulophus* sp., *Elasmus leucopterae*, Ferrière, *Cirrospilus cinctiventris* and *Atoposoma*; females oviposit indiscriminately on primary or secondary hosts, regardless of their own origin. When primary, the host usually pupates. Parthenogenesis is common and results in males only. *Chrysocharis* sp. is recorded from examples developing on *Eulophus* sp.

Borkhsenius (N. S.). **Notes on *Pseudococcus comstocki* (Kuw.) and some allied Species (Homoptera : Coccoidea), with Descriptions of three new Species.**—*Bull. ent. Res.* **39** pt. 3 pp. 417–421, 3 refs. London, 1948.

In view of the absence of any satisfactory method of distinguishing *Pseudococcus comstocki*, Kuw., from closely related species other than *P. maritimus*, Ehrh., and of the increasing range and economic importance of this group of mealybugs [*cf. R.A.E.*, A **36** 409, etc.], morphological studies were made with large quantities of material from various parts of the world. This included *P. comstocki* from different food-plants in Tashkent and New York State, *P. maritimus* from different food-plants in various parts of the Soviet Union, and in Norway, Palestine, the United States, Argentina and Chile, and *P. citriculus*, Green, from *Citrus* in Palestine; large numbers of mealybugs on bananas received at Leningrad from Colombia in 1939 included three new species, which are described from the adult females as *P. elisae*, *P. peregrinabundus*, and *P. colombianus*. On the basis of this work, the author enumerates the most consistent characters separating *P. comstocki* from allied species, and gives keys to the adult females of the six species considered and to the first- and second-stage larvae and pre-adult females of *P. comstocki* and *P. maritimus*.

Simmonds (F. J.). **Some Difficulties in determining by means of Field Samples the true Value of parasitic Control.**—*Bull. ent. Res.* **39** pt. 3 pp. 435–440. London, 1948.

The usual method of estimating the relative efficiency of insect parasites in controlling their hosts is to collect samples of host material in the field, note the parasite species present and compare the percentages of hosts attacked by them. This process will give poor results if only a few small, localised, collections are made and is also open to several objections of a biological nature. Samples so collected are removed from further attack, one consequence of which may be that parasites that attack host larvae of different ages are unequally represented. The populations of both host and parasites are continually developing, and the percentage parasitism obtained will vary with the point in the developmental cycle at which the sample is taken. Overlapping generations of both parasite and host add to the complexity and some parasites complete several generations in one generation of their host. Parasitism varies with the availability of hosts and with the ability of the parasites to find them and may thus be high in some situations and low in others.

During work in Trinidad on parasitism of the eggs of *Physonota alutacea*, Boh., by an undescribed species of *Horismenus*, carried out in connection with investigations of the possible biological control of the weed, *Cordia macrostachya*, in Mauritius [*cf. R.A.E.*, A **36** 424], it was found that parasitised eggs persisted

longer than unparasitised ones, which tended to cause an overestimate of the rate of parasitism, and that the eggs are not attacked until they are a few days old, which tended to cause an underestimate. A correction for these two factors and for the reduction in parasitism caused by the removal of host material from the field in sampling is calculated. When it was applied to an actual sample of *Physonota* eggs taken in September 1946, the observed parasitism of 79·6 per cent. was increased to 90·7 per cent. With suitable modifications, this correction can be applied to samples of hosts in other stages of development.

Though drawing attention to the existence of these and other defects of simple sampling methods, the author does not consider the latter incapable under any circumstances of providing data on which valid estimates can be based. He points out, however, that field parasitism must be studied over a wide range of conditions and that effectiveness can then usually be better expressed in general terms than as percentages of parasitism, which may be of little significance in circumstances other than those at the point in space and time at which the sample was taken.

BARNES (H. F.). **Gall Midges of economic Importance. Vol. IV. Gall Midges of ornamental Plants and Shrubs.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., 165 pp., 10 pls., 2 figs., 343 refs. London, Crosby Lockwood & Son, Ltd., 1948. Price 15*s*.

This fourth volume of a series on Cecidomyiids of economic importance deals with those that attack ornamental plants and shrubs and resembles the previous three [*R.A.E.*, A **34** 251 ; **36** 308] in scope and arrangement.

CONDIT (I. J.). **The Fig.**—$10\frac{1}{2} \times 7$ ins., xviii, 222 pp., frontis., 27 figs., $18\frac{1}{2}$ pp. refs. Waltham, Mass., Chronica Botanica Co. ; London, Wm. Dawson & Sons, Ltd., 1947. Price $5 or 30*s*.

This book deals with all aspects of the history, botany and cultivation of the fig tree and the marketing and uses of the fruit, with special reference to the United States. It contains a chapter describing the process and effect of caprification by *Blastophaga psenes*, L., and its utilisation in fig cultivation, and two others on diseases and pests, respectively, in various parts of the world. Most of the latter are insects, and notes are given from the literature on their habits and importance. A short section is included on insects that infest dried figs and their control.

Report of the Fifth Commonwealth Entomological Conference 22nd–30th July 1948.—[1+]ii+112 pp., 3 refs. London, Commonw. Inst. Ent., 1948. Price 7*s*. 6*d*.

In addition to an account of the Fifth Commonwealth Entomological Conference, which was held at London in July 1948, with the resolutions passed by it, this report includes three appendices. The first is a memorandum on the work of the Commonwealth Institute of Entomology from April 1935 to March 1948, the second contains reports of the proceedings of committees, including one dealing with termite control and another with the nomenclature of insecticidal chemicals, and the third contains the text of the papers read at the scientific meetings and reports of the discussions that followed them. The subjects for discussion, with (in brackets) the authors of the opening papers [*cf.* also *R.A.E.*, B **37** 67], included Recent Developments in Insecticides, pp. 28–35 (R. A. E. Galley) ; Mode of Action of new Insecticides, pp. 35–37 (V. B. Wigglesworth) ; Uses and Limitations of the new Insecticides in the Field, pp. 38–45 (W. A. Ross) ; Recent Developments in Pest and Disease

Control Machinery, pp. 45–54 (H. G. H. Kearns, G. H. Berkeley) ; Application of Insecticides from the Air, pp. 54–59 (D. L. Gunn) ; Biological Control [of insects and weeds], pp. 60–72 (A. B. Baird, W. Cottier, R. H. Le Pelley, D. Miller) ; Estimation of Insect Populations in the Field, pp. 72–76 (A. H. Strickland) ; Developments in the Control of Stored Products Insects, pp. 77–83 (F. N. Ratcliffe) ; The Need for Plant Quarantine on a continental Basis, with special Reference to Africa, pp. 89–91 (G. F. Clay) ; and Locusts and Grasshoppers, pp. 94–100 (B. P. Uvarov, A. J. Nicholson). A summary of information on termites that was circulated among the delegates is reproduced and a report of the discussion on it appended (pp. 100–112).

Wiesmann (R.). **Untersuchungen über die Eintrittspforten des Dichlordiphenyltrichloraethan (DDT) in den Insektenkörper.** [Investigations on the Sites of Penetration of DDT into the Body of an Insect.]—*Verh. schweiz. naturf. Ges.* **126** pp. 166–167. Aarau, 1946.

The points at which DDT enters the bodies of insects were investigated in the laboratory by touching various sites with a solution of DDT in oil. The test insects were chiefly adults of *Calliphora vomitoria*, L., but adults of *Blattella* (*Phyllodromia*) *germanica*, L., and full-fed larvae of *Cydia* (*Laspeyresia*) *pomonella*, L., and *Calliphora* were also used.

Typical symptoms of DDT poisoning were produced by touching the sense organs on the veins of the wings of *Calliphora* but not by touching other parts of the veins or the wing cells. The rapidity with which the symptoms appeared depended on the proximity of the treated sense organs to the base of the wings. Symptoms also occurred after touching the proboscis, genae, antennae and halteres (which all bear sense organs), and the intersegmental skin on the abdomen, but not after touching the upper side of the thorax, the sternites and tergites of the abdomen or the compound eyes. Similar results were obtained with *Blattella*, but there were no reactions in corresponding tests with the larvae of *Calliphora* and *Cydia*, which pupated and gave rise to normal adults.

It is concluded that the penetration of DDT is dependent on the structure and chemical composition of the cuticle and the lipophile properties of DDT. In the parts that are not permeable, resistance is due to the high sclerotin content of the exo- and endocuticle ; and in larvae that are resistant to DDT, the epicuticle is polymerised to form a complete and impenetrable covering for the whole body. Unlike the sites that are impermeable, the penetrable ones, including even the sense-organ pores, not only have an epicuticle that contains lipoids, but also either have very thin, unpigmented and flexible exo- and endocuticles containing little or no sclerotin, or, as in the sense-organ pores, lack these layers completely. Penetration through the sense-organ pores and the intersegmental skin is due to the presence of lipoids.

Ferrière (C.). **Les espèces ou races biologiques de *Trichogramma* (Hym. Chalc.).**—*Verh. schweiz. naturf. Ges.* **127** pp. 92–93. Aarau, 1947.

In a previous paper [*R.A.E.*, A **12** 558], the author considered that there was only one European species of *Trichogramma*, namely *T. evanescens*, Westw., with several biological races ; he now concludes, largely from the results of Marchal [**15** 653 ; **25** 325] and Salt [**26** 102 ; **27** 390], that at least four biotypes can be distinguished. These comprise, firstly, *evanescens*, with bisexual development, arrhenotokous parthenogenesis, and males always alate except for small brachypterous ones (runts) with normal antennae ; secondly, *semblidis*, Auriv., with bisexual development, arrhenotokous parthenogenesis and dimorphism of the males, which are either alate with normal antennae (from eggs of Lepidoptera and obtained by the author in one instance from those of *Tabanus*

[*cf.* also **7** 231 ; **16** 441]) or apterous with gynaecoid antennae (from eggs of *Sialis*) ; thirdly, *cacoeciae*, Marchal, more yellow in colour, which has thelytokous parthenogenesis, males being very rare, and produces two generations a year in eggs of *Tortrix* (*Cacoecia*), with a larval diapause and micropterous females in spring, and 7–8 generations a year in eggs of other Lepidoptera, without diapause or micropterism ; and, fourthly, a form developing in eggs of *Cydia* (*Carpocapsa*) [*pomonella*, L.], which has thelytokous parthenogenesis and no males and is less well known.

Discussing the question whether these are species or races, the author points out that species are distinguished by morphological differences in conjunction with sexual segregation. As regards morphology, the coloration of these forms generally varies with the temperature and the host eggs, while the number of hairs in the rows on the wings varies with the size [*cf.* **24** 626] ; there are clearer differences in the relative length of the hairs on the antennae of the males of *evanescens* and *semblidis*, but they have not been checked biometrically. There is no geographical segregation of forms, but there is often real biological or ecological segregation, owing to natural adaptation to the eggs of certain hosts. Genetic segregation was apparent in tests in which *evanescens* was unsuccessfully mated with *semblidis* and *cacoeciae*, but further work is required. The author therefore still prefers to consider the European forms of *Trichogramma* as biological races of *T. evanescens*.

Clausen (R.-L.). **La lutte contre le hanneton** *Melolontha melolontha* **L.**—*Verh. schweiz. naturf. Ges.* **127** pp. 93–94, 9 refs. Aarau, 1947.

Two applications, at weekly intervals, of suspensions of BHC (benzene hexachloride) at 1·95 lb. per 100 gals. and DDT at 2 lb. were applied to plum trees in Switzerland to protect them from attack by adults of *Melolontha melolontha*, L. The materials were about equally effective and, a fortnight after the second application, the amount of damage on the upper parts of the trees was less than half that on the controls, which were fairly severely injured. In laboratory tests, the adults reacted rapidly to contact with DDT, but died slowly, whereas they did not at first appear to be affected by treatment with BHC, but then succumbed rapidly. The average mortalities obtained by moistening the thorax with a drop of BHC or DDT were in the ratio 1 : 2. When offered sprayed and untreated leaves, the beetles consumed, on an average, more of the former than of the latter and more of the leaves treated with BHC than of those treated with DDT. When trees were sprayed with a suspension of BHC at 2·6–3·9 lb. per 100 gals., the beetles were killed in 48 hours even 11–13 days after application, and a suspension of DDT at 2–3 lb. per 100 gals. was similarly toxic in 72–96 hours after 10–16 days.

Watzl (O.). **Vorstudien und Beobachtungen über die Entwicklung des Kartoffelkäfers in Österreich.** [Preliminary Studies and Observations on the Development of the Potato Beetle in Austria.]—*Pflanzenschutzberichte* **1** no. 3–4 pp. 33–48, 1 fig., 8 refs. Vienna, 1947.

Following the spread of *Leptinotarsa decemlineata*, Say, into western Austria in 1945 [*cf. R.A.E.*, A **35** 380], adult beetles were found in potato fields there in 1946 between 11th May and 9th August, eggs between 20th May and 26th July, and larvae between 21st May and 7th August. With a view to ascertaining the rate of the development of the pest, breeding experiments were carried out at Wels in Upper Austria. All stages are described and notes on the bionomics are given. At temperatures of 20–24°C. [68–75·2°F.] in the laboratory, the life-cycle was completed in 39–52·5 days, with an average of 45·75, of which the egg stage lasted 6 days, the larval stage 19·5 (including

3·75 days passed in the soil before pupation), the pupal stage 9·5 days, and the preoviposition period 10·75 days. Field records showed that overwintered adults were most abundant in the second half of June. Adults of the first (summer) generation appeared in July and reached their peak of abundance in the second half of July in the warmer parts and in the first half of August in the colder mountainous ones. Larvae of the second generation occurred in late July and early August, and it is concluded from these and similar observations in 1945 and the laboratory tests that there may be two complete generations a year in the plain south of Lake Constance and in most of Upper Austria between the Danube and the lower Alps, the adults of the second generation emerging in September or even October. There is likely to be only a partial second generation in the colder areas in the west, but should the beetle spread to the favourable areas of eastern Austria, there might even be a partial third generation. The reproduction potential of the overwintered females is discussed, and the necessity for intense preventive control measures is emphasised.

Österreichischer Pflanzenschutzdienst. **Auftreten des Kartoffelkäfers im Jahre 1947 in Österreich. Kartoffelkäferauftreten in Ungarn.** [Austrian Plant Protection Service. The Occurrence of the Potato Beetle in the Year 1947 in Austria. The Potato Beetle in Hungary.]—*Pflanzenschutzberichte* **1** no. 3–4 p. 62. Vienna, 1947.

In Austria in 1947, adults or larvae of the Colorado potato beetle, *Leptinotarsa decemlineata*, Say, were found in 66 districts in the Vorarlberg, 9 in the Tyrol, 36 in Upper Austria, 4 in Salzburg, and one in Lower Austria. Control measures were applied to all infested areas.

The beetle was also found in 1947 for the first time in Hungary, near Magyarovar, about 25 miles from the Austrian frontier. It had apparently been introduced with some seed potatoes with much soil adhering to them that had been imported from Germany. Numerous adults and larvae were observed, and immediate control measures were taken.

Thiem (H.). **Die Maikäferbekämpfung mit neuzeitlichen Insektengiften.** [Control of Cockchafers by means of modern Insecticides.]—*NachrBl. dtsch. PflSchDienst* (N.S.) **1** pt. 1 pp. 4–5, 2 refs. Berlin, 1947.—*T.c.* pt. 2 pp. 26–28.

The author briefly reviews previous work in Germany on the control of the adults of *Melolontha* by means of insecticides [*cf. R.A.E.*, A **31** 139] and gives an account of a large-scale field experiment in 1944 in which the fruit trees in an isolated infested district in the Rhineland were dusted or sprayed with DDT (Gesarol). The sprays were applied from the ground, two applications being made in the periods between 26th April and 6th May and 6th and 15th May, and the dusts were applied from an aeroplane and in some cases from the ground in early May. The beetles were on the wing from 24th April till 2nd June, and the flight was moderately heavy, the peak being reached on 6th May. Both *M. melolontha*, L., and *M. hippocastani*, F., were present, the latter being the more numerous. From observations of the number of exit holes in the ground, it was estimated that some 9 millions were involved in the flight. Oviposition began in the middle of May.

The immediate effect of the treatments was estimated by observing the amount of defoliation of the trees, counting the dead and paralysed beetles on the ground, and collecting beetles from treated and untreated trees for further observation. The main conclusions drawn were that DDT acts on both species chiefly as a contact poison and that there is considerable individual variation in reaction to it. Resistance decreased with the age of the beetles and males

usually succumbed much more quickly than females. Both the spray and the dust acted as a repellent, the beetles avoiding the treated trees for some 4–6 days. The beetles continued to drop from treated trees for 8–9 days and in some cases for up to 14 days or longer. Less than half of them died under the trees, and many were able to fly away after first falling to the ground, but the steady increase in dead beetles near the circumference of the experimental area indicated that the majority of them eventually died. A few affected females oviposited prematurely.

The ultimate effect of the treatment was estimated later by examining soil samples for first-year larvae, and the results showed that the populations per unit area were much lower in treated than in neighbouring untreated areas. No larvae were found in 61 per cent. of the diggings effected in the treated area and considerable numbers in only 1 per cent. of them. It is concluded from all the observations made that 90 per cent. of the beetles must have been killed and that little damage by larvae was to be expected before the next flight, which would be reduced. The treatment had no ill-effect on the people engaged in the work or on the trees or undergrowth, and there were no complaints of poisoning of bees.

THIEM (H.). **Die San-José-Schildlaus an der Bergstrasse.** [The San José Scale in the District of the Bergstrasse.]—*NachrBl. dtsch. PflSchDienst* (N.S.) **1** pt. 2 pp. 25–26. Berlin, 1947.

Quadraspidiotus (*Aspidiotus*) *perniciosus*, Comst., which was found in the Rhineland for the first time in February 1946, has become widely distributed in the fruit-growing district of the Bergstrasse, near Heidelberg, and to the south of it as far as Kraichgau, the centre of the spread apparently being Dossenheim. The local distribution of the Coccid is outlined. The chief plants attacked are currant bushes and apple trees, but gooseberries, cherries, pears, and stone-fruits are also infested. The damage caused to currants and apples and the resulting losses are discussed. The present distribution of the scale indicates that it must have been introduced into the area a considerable time ago, presumably on infested nursery stock.

ROEPKE (W.). **De rijpingsvraat van de eikenspintkever,** *Scolytus intricatus* **Ratzeb.** [Maturation Feeding of the Oak Bark-beetle, *S. intricatus*.]—*Tijdschr. PlZiekt.* **53** no. 4 pp. 114–116. Wageningen, 1947. (With a Summary in English.)

Scolytus intricatus, Ratz., is normally rare in Holland, but became common after 1940 on oak trees that had been damaged during hostilities. As a result of the maturation feeding of the adults in spring, observations on which are recorded, clusters of leaves become withered and discoloured and the twigs die and fall, particularly in windy weather.

It is stated that the species of *Scolytus*, thought to be *S. mali*, Bechst., of which maturation feeding on cherry was recorded in 1940 [*R.A.E.*, A **34** 67], has since been found to be *S. rugulosus*, Ratz.

De appelbloesemkever. [The Apple-blossom Weevil.]—*Versl. PlZiekt. Dienst Wageningen* no. 105 (3rd revd. edn.), 22 pp., 15 figs. Wageningen, 1947.

This bulletin on the bionomics, distribution and control of *Anthonomus pomorum*, L., on apple in Holland is based on the work of Huysmans and van Asperen [*cf. R.A.E.*, A **34** 93, 94] and further experiments on its control with DDT and other insecticides in 1944–46, the results of which are given. Good control of the overwintered adults was obtained with DDT sprays prepared

from various preparations diluted to give about 0·05 per cent. actual DDT. It was found that they are best applied while the weevils are active on the trees but before they oviposit. The most suitable time for treating most varieties of apple is just before the buds reach the "mouse-ear" stage, but some late-flowering varieties should be sprayed still earlier. Comparative tests showed that infestation was considerably higher after spraying with dinitro-o-cresol than after spraying with DDT or a mixture of the two. Certain proprietary preparations containing mineral oil, dinitro-o-cresol and DDT, which are effective against the overwintering eggs of *Paratetranychus pilosus*, C. & F., *Operophtera brumata*, L. and Aphids also control *A. pomorum* under favourable conditions [*cf.* **36** 276], but must be applied comparatively late in order to do so, with consequent risk of damage by Aphids and other pests before spraying is carried out.

Despite the promising control of *Anthonomus* given by DDT, banding the trees is still of value. In 1944, 2,937 dead weevils were found on 22nd March under 43 bands that had been thoroughly sprayed with dinitro-o-cresol on 16th March.

Golding (F. D.). **The Insect Pests of Nigerian Crops and Stock.**—*Spec. Bull. agric. Dep. Nigeria* no. 4, [1+]48 pp. Lagos, 1946.

This bulletin includes a list of crops in Nigeria, showing the insects that attack the various parts of each and the injurious stages, to which one of stored products with their insect pests is appended, another of the insects showing the plants or plant products on which each feeds, a bibliography of the literature dealing with the crop pests, termites and wild silk moths (*Anaphe* spp.) of West Africa and brief notes on the major pests of crops in Nigeria and their control.

Schouteden (H.). **Les Bryocorines (Mirides) du Congo Belge.**—*Rev. Zool. Bot. afr.* **39** fasc. 2–3 pp. 274–289, 2 refs. Brussels, 1946.

The species discussed include the two for which the author erected the genus *Ealincola* [*R.A.E.*, A **34** 81]; he retains *E. modestus*, Dist., in this genus, but transfers *E. thoracicus*, Dist., to *Pantilioforma*. He erects the new genus *Parachamus* for *Chamus bellus*, Dist. [**6** 332] and considers *Poppiusia combretorum*, China [**32** 419] a synonym of *P.* (*Arculanus*) *leroyi*, Schout.

Gunn (D. L.) & others. **Behaviour of the Desert Locust** (*Schistocerca gregaria* **Forskål) in Relation to Aircraft Spraying.**—*Anti-Locust Bull.* no. 3, 70 pp., 8 pls., 21 figs., 45 refs. London, 1948.

The following is taken almost entirely from the authors' summary. The behaviour of settled swarms of *Schistocerca gregaria*, Forsk., was studied in the Kenya Highlands in 1945 in connection with the possibility of destroying them by means of sprays applied from aircraft [*cf. R.A.E.*, A **36** 375]. Observations were made on winged but sexually immature locusts on 17 days, starting before or soon after sunrise and continuing until the swarm had departed. Ten of the 85 sets of observations refer to one large swarm, or to parts of it, that was followed for 18 days. Observations were made on the relation of locust behaviour to air temperature, humidity, body temperature, radiation, and speed and direction of wind.

The locusts always roosted for the night on trees or bushes, except on one occasion when many of them were on tall grass and herbs. Some time after sunrise, a descent to the ground began, but many remained in the trees until they flew away. On the ground, principally on bare patches, they at first orientated their bodies at right angles to the sun's rays and generally remained

in this position until the swarm left, but on several occasions some or many of them re-orientated themselves in line with the rays. Once the progressive descent from the trees had become established there were always locusts flying, and there was a progressive increase in the number flying about, as distinct from flying down from the trees. At a time that could usually be determined within ten minutes, migration began, with a widespread taking to flight and streaming away in one direction ; the whole swarm generally took a considerable time to evacuate the site completely.

The half-hour of increasing light before sunrise is the most unfavourable time for spraying from the air, since many of the locusts are then inside the trees and so sheltered from the spray. If this difficulty were overcome, it would be the most favourable time, since the locusts are motionless. Once the sun appears, there is a movement to the eastern side of the trees and eventually a progressive descent to the basking places on the ground. Some extension of the swarm generally occurs then, but basking occurs mostly within a few score metres of the roosts and largely within the original roosting area, in patches where there are no trees. Consequently there is a progressive increase in the number of locusts arranged ideally for attack, basking in some patches as densely as several hundreds to the square metre. At the same time, however, there is a progressive increase in the number of locusts in flight ; a proportion of these will, by random movements, avoid the spray, while eventually the flying locusts become hazardous to low-flying aircraft. In the absence of methods of estimating densities of locusts on trees and bushes, accurate comparison of the relative numbers on the ground and in the trees at any moment is impossible, but it could be seen, by comparison with the migrating swarm, that the number flying about before the departure of the swarm was never a high proportion of the whole. Consequently the best time to spray would appear to be as late as possible, provided that spraying can be completed before the flying locusts endanger the aircraft.

Roosting locusts are not easily visible from an aeroplane and would not be visible even from a helicopter until basking was well established. They become visible at certain angles in sunshine only when flying down densely from the trees. Consequently a ground party is required to delimit and to demarcate the swarm, processes that can hardly be started in darkness or completed before sunrise. The lengths of time required for demarcation and for spraying both depend on the size of the swarm, the terrain, and other factors. Estimates of the times that would have been available for these operations with the swarms studied, based on observations of their behaviour, indicated that useful predictions could not be made on the basis of previously observed times, and some correlation with environmental factors is desirable.

The correlation with weather factors of the time of departure of the swarm and, to a less extent, of the beginning of the descent from the trees, was investigated. Neither appeared to be related to air humidity or the speed or direction of wind, there was no satisfactory consistency in body temperatures, and no simple, direct connection with direct solar radiation ; total radiation, including reflection, was much greater, but could not be suitable measured. The most consistent data were for air temperature ; this was 15–19°C. [59–66·2°F.] at the beginning of the descent from the trees and 17–23°C. [62·6–73·4°F.] when the swarm began to leave, with averages of 17 and 20°C. [68°F.], respectively. These temperature ranges are too wide for precise prediction, and suggest that the variations in time were due not only to variations in weather, but also to real variations in behaviour.

The density of a swarm may affect the readiness with which it begins to leave, but there appear to be no substantial grounds for regarding density as a factor likely to alter the air temperature at which the swarm departs ; nevertheless, it remains a possible source of variation. The body temperature was always

above the permissible temperature for flight (20°C.) at the time of departure, and the maximum temperatures of locusts caught at that time on different days ranged from 27 to 41°C. [80·6–105·8°F.]. Since departure results from sustained flight, as distinct from the short flights common earlier in the day, and since representative body temperatures from locusts in sustained flight could not be obtained, it remains possible that there is a relation between body temperature in flight and departure. When the general weather was warm, the locusts left at a higher temperature than when it was cooler, a change of 1°C. [1·8°F.] in the previous day's maximum air temperature corresponding to a change of about half as much in the air temperature at which the swarm left. By extrapolating from the data, it appeared that with a daily maximum of 13°C. [55·4°F.], the swarm would not leave the roosting site, whereas with one of 40°C. [104°F.], it would start at 27°C. It is not clear how a locust that is much warmer than the air can react in this way to air temperature, but appendages carrying receptors may be little if any warmer than the air.

The direction of migration at the time of departure was with the wind when its speed was 5 ft. per second or over, and against or across it at lower speeds. No simple correlation could be found between the wind and the direction of migration of the swarm that was followed for 18 days, but the wind data were inadequate. This swarm kept over ground at a fairly constant altitude of about 6,000 ft. until it descended to the plains, where egg-laying began. Another swarm that was observed during cool weather moved roughly as would be expected if carried passively by the wind.

A few data indicated that swarm settling occurred at air temperatures of 20–23°C., both during the day and in the evening.

Photographic methods of finding the density of swarms of locusts flying near the ground and of locusts basking on flat ground and in certain other simple situations are described. The number of locusts in a swarm settled on bushes can be estimated by drenching strips across the swarm with a suitable insecticide applied from a low-flying aeroplane, counting the dead locusts in sample areas and estimating the proportion of the treated to the untreated areas. On two occasions, densities of about 660,000 locusts (1 ton) per acre were found and once the density may have approached 700 tons per acre.

Pradhan (S.) & Menon (R.). **Insect Population Studies. I. Distribution and Sampling of Spotted Bollworm of Cotton.**—*Proc. nat. Inst. Sci. India* **11** no. 2 pp. 61–73, 27 figs., 3 refs. Calcutta, 1945.

The authors point out the importance in the study of the fluctuation of insect populations of developing sound techniques for the estimation of the numbers of insects as well as for quantitative measurement of factors governing change in numbers, and give the results of work done in India while investigating the statistical aspect of the technique of population estimation in the field. They describe precision experiments, in which a plot of suitable size is divided into the smallest practicable units and examined unit by unit, after which the data are combined to form units of all the various possible kinds, sizes and shapes and the suitability and desirability of the various units are judged by determining and comparing the statistical constants based on each type. These were carried out three times with the spotted bollworm of cotton [*Earias fabia*, Stoll].

For each experiment, a plot 33 ft. square was selected at random from a field of cotton, and data were obtained for individual plants and then combined to give the results for lengths of 1–4 ft. along the row, for 2–4 ft. in adjacent rows and for samples of 1–6 plants along the row and of 2–10 plants taken at random. The distribution of the larvae in one of the plots is shown in a diagram and the frequency distributions observed and calculated for different types of sample units are illustrated on graphs. These show that distribution tends from absolute

skewness with the smallest unit towards normality in the larger units. The shape of the sample units appeared to have less effect on the nature of frequency distribution than their size. Statistical analysis showed that units formed by the combination of random plants were better than other types of the same size, and that the coefficient of variance decreased as the size of the sample increased, but the standard error increased as the number of samples decreased. It is concluded that the samples should be large enough to contain a normal distribution, but no larger, as although the coefficient of variance continued to decrease with increase in the size of the samples, the actual range of variation increased. Units of 5–7 random plants appeared to be of a suitable size. As the analysis of variance shows generally greater variation between rows than within them, as many rows as practicable should be included when sampling, and as there is rather significant correlation between the number of bollworms and the condition of the plants as indicated by the number of buds and bolls on them, it may be worth while to study the population fluctuation with the help of adjusted population.

PRADHAN (S.). **Insect Population Studies. II. Rate of Insect-Development under variable Temperature of the Field.**—*Proc. nat. Inst. Sci. India* **11** no. 2 pp. 74–80, 1 fig., 6 refs. Calcutta, 1945.

Observations in India on the duration of the pupal stage of *Earias fabia*, Stoll, at variable and constant temperatures have indicated that development is quicker under variable than under constant temperatures at low temperatures, but slower under variable than under constant temperatures at high ones. The author therefore investigates the forms of curve obtained when rate of development is plotted against temperature, and he finds that a sigmoid curve gives the best fit. This means that the rate of development increases as the temperature rises, but the acceleration in this rate increases as the temperature rises in the lower temperature range and decreases as it rises in the higher one. In any fluctuation of temperature in the lower range, therefore, the effect of temperature above the average in increasing rate of development is greater than the effect of temperature below the average in reducing it, and development is more rapid than if the temperature were kept constant at the average ; the reverse is true for any fluctuation in the upper range.

Methods of calculating the rate of development corresponding to any constant temperature and to any range of temperature fluctuation, and hence the accelerating or retarding effect of variable temperature, are shown and illustrated by a numerical example. The calculations show that not only the average temperature but every point in the whole range of temperature fluctuation has an effect on the development period under variable temperatures, and that the length of this period would be quite different if the range of fluctuation changed even though the average did not. In these calculations it is assumed that fluctuations in temperature are quite regular, whereas this is not strictly true under natural conditions.

VAN ZWALUWENBURG (R. H.). **Recent immigrant Insects.**—*Hawaii. Plant. Rec.* **50** no. 1 pp. 11–17, 4 figs., 5 refs. Honolulu, 1946.

Some of the information in these notes on 15 insects recorded in Hawaii for the first time during the period of 19 months that elapsed between the summer of 1944 and early 1946 has already been noticed [*R.A.E.*, A **37** 78–79]. Most of the insects were taken in light-traps operated near airports to provide prompt indication of the arrival of living insects in aircraft. The distribution of *Anacamptodes fragilaria*, Grossbeck, is extended to include Kauai, Maui, Molokai and Niihau. It caused some damage to leguminous forage trees and

shrubs on Oahu in February 1945, but the plants recovered. It again became numerous in February 1946, and it is considered probable that outbreaks may occur each winter. The predacious Reduviid, *Zelus renardii*, Kol., was found to attack it in the field, but is unlikely alone to cause the seasonal decline in its numbers. It is stated in a footnote that larvae on *Ocimum basilicum* were parasitised by the Tachinid, *Achaetoneura* (*Frontina*) *archippivora*, Will. An undescribed species of *Apanteles* found attacking the larvae in California in 1945 was released on Oahu. *Achaea janata*, L., which is also common in winter, is now established on Hawaii, Kauai, Lanai, Maui, Molokai and Oahu, and is known to attack 14 different plants, sometimes causing severe damage to castor (*Ricinus* [*communis*]) and Chinese cabbage [*Brassica chinensis*]. Adults and larvae of theNoctuid, *Amyna natalis*, Wlk., were found on Oahu; the larvae were feeding on *Sida cordifolia*, *S. rhombifolia*, *Waltheria americana* and *Abutilon incanum*, and some were attacked by the introduced parasites, *Meteorus laphygmae*, Vier., and *Blondelia* (*Eucelatoria*) *armigera*, Coq. [*cf.* **34** 171, etc.].

Williams (F. X.). **Entomology.**—*Rep. Comm. Exp. Sta. Hawaii. Sug. Pl. Ass. 1944–45* pp. 16–22. Honolulu, 1946.

Much of the information in this report of work on insect pests in Hawaii during the year ended 30th September 1945 has already been noticed [*cf.* preceding abstract and *R.A.E.*, A **37** 78–79]. *Laphygma exempta*, Wlk., had been scarce on the island of Hawaii for several years, but young larvae were numerous during May and June on several sugar-cane plantations. The introduced parasites, *Apanteles marginiventris*, Cress., and *Meteorus laphygmae*, Vier. [*cf.* **34** 3, 171], were present in every case and often abundant. By mid-July, *L. exempta* had disappeared, evidently chiefly as a result of their activity, since longer-established parasites were uncommon.

During the year, some 12,338 insects were taken from Army and Navy aeroplanes landing at Oahu from regions outside the Territory. Only 88 of these were alive [*cf.* **34** 171], but about 20 of them represented species that do not occur in Hawaii. The new living insects included *Anomala sulcatula*, Burm., *Plusia* (*Autographa*) *californica*, Speyer, and *Melanophila consputa*, Lec., and the dead ones, *Locusta migratoria*, L. (*danica*, L.), *Nezara viridula*, L., *Diabrotica duodecimpunctata*, F., *D. undecimpunctata*, Mannh. (*soror*, Lec.), and *Popillia japonica*, Newm.

Barthel (W. F.), Gersdorff (W. A.), Laforge (F. B.) & Graham (J. J. T.). **Evaluating Pyrethrum Extract. A Comparison of chemical and biological Methods of evaluating concentrated Extracts.**—*Soap & sanit. Chem.* **22** no. 3 pp. 129, 131, 9 refs. New York, N.Y., 1946.

The following is taken partly from the authors' summary. Comparison of chemical analyses of a sample of purified pyrethrum extract prepared by the nitromethane-charcoal process [*R.A.E.*, A **33** 189] showed that the Seil method of analysis gave consistently lower contents of pyrethrins than either the A.O.A.C. or the hydrogenation method. Biological comparisons against house-flies (*Musca domestica*, L.) of sprays prepared from four purified preparations with a standard spray, all at concentrations based on the A.O.A.C. evaluation, showed that all four underwent purification without loss of insecticidal activity, and one of them retained its full activity for ten months when kept at a temperature of 2°C. [35·6°F.], whereas a commercially prepared pyrethrum concentrate (20 per cent. for aerosols) showed a continuous loss of toxicity to flies when stored at room temperature and a 27 per cent. loss of pyrethrins at the end of eight months. According to analysis by the A.O.A.C. method, the percentage of pyrethrin I to total pyrethrins was 53 in the purified

material and 55 in a standard pyrethrum extract. Since pyrethrin I causes higher mortality of house-flies than pyrethrin II, the standard extract should be slightly the more toxic at comparable concentrations.

YEAGER (J. F.) & MUNSON (S. C.). **Analysis of Concentration-Survival Time Curves of arsenite-injected Roaches having different Resistances.**—*Ann. ent. Soc. Amer.* **39** no. 1 pp. 145–151, 2 graphs, 1 ref. Columbus, Ohio, 1946.

The following is substantially the authors' summary. Further analysis of data obtained in experiments with *Periplaneta americana*, L., previously recorded [*R.A.E.*, A **33** 64 ; **37** 96] has led to certain indications of the reason why some cockroaches injected with a given dose of sodium metarsenite survived for short times, whereas others injected with an equal dose survived longer. An interpretation of the results of this analysis indicates that such differences in survival times are associated with, and may be in part caused by, firstly, differences in the electrolytic dissociation of the poison in the blood of the insects, which may involve differences in the degree of dissociation at high concentrations, the rate of change of degree of dissociation with change of concentration, and the concentration at which complete dissociation is attained ; and, secondly, differences in the capacity of the insect to render ineffective some of the poison that it received, differences in quantity of vital tissues, or differences in both. It is suggested that among the physiological factors that may be involved in the first group are blood volume and chemical composition of the plasma, and in the second group, processes of detoxification and excretion.

These results are also in accord with the idea that the mixing of the poison with the blood and its distribution by it occur more slowly in those insects that have longer survival times. The inflection appears to be more marked in the short than in the long survival-time curves.

DUSTAN (G. G.). **Effect of Temperature on Toxicity of DDT.**—*Canad. Ent.* **79** no. 1 pp. 1–4, 1 graph, 1 ref. Guelph, Ont., 1947.

Experiments conducted in temperature-control cabinets in a greenhouse in Ontario during the winter of 1945 showed that temperature had a marked effect on the toxicity of DDT to larvae of *Plutella maculipennis*, Curt., and *Phlyctaenia rubigalis*, Gn. The DDT was used at various concentrations as an emulsified solution and, in one test, as a powder suspension ; its contact action was tested on both species and its stomach action on *Plutella*. Mortality steadily increased as the temperature rose between 60 and 95°F., even when considerably more of the spray deposit was ingested at the higher temperature than at the lower.

A similar effect of temperature on the toxicity of DDT to house-flies [*Musca domestica*, L.] has been recorded [*cf. R.A.E.*, B **34** 134].

BIRD (R. D.). **The Sweetclover Weevil,** *Sitona cylindricollis* **Fahr.**—*Canad. Ent.* **79** no. 1 pp. 5–11, 8 refs. Guelph, Ont., 1947.

An account is given of investigations in 1944–46 on the bionomics and control of *Sitona cylindricollis*, Fhs., on sweet clover [*Melilotus*] in Manitoba, where it was first observed in 1939. The date of introduction of this European weevil into North America is not known, but it had been found in Canada before it was first recorded in the United States [*R.A.E.*, A **22** 256]. It was taken in Quebec in 1924 and 1925, was locally abundant there in 1927 and in Ontario in 1928, and was found in New Brunswick in 1939. It caused severe damage to sweet clover in Ontario in 1935 [**25** 368], was widespread in Manitoba in 1939, completely defoliated a field of sweet clover in Saskatchewan in 1940,

and was locally abundant in Alberta by 1943. Damage by it to sweet clover in Manitoba was severe in 1939 and 1940, somewhat reduced in 1941 and 1942, and severe again in the next three years.

The following is substantially the author's summary. Sweet clover is by far the most favoured food-plant, and all the common varieties grown in Manitoba are attacked, although a few appear to be slightly resistant. The adults eat crescent-shaped pieces out of the leaves in spring and autumn, causing the chief damage, and the larvae feed on the root hairs and nodules in summer. Lucerne is attacked only when sweet clover is scarce. The adults overwinter in surface trash and in the soil to a depth of 1 in. Emergence from hibernation occurred between late April and July, and in 1945 there were peaks during periods in May and June with mean daily temperatures of about 60°F. preceded by rainfall. Migration takes place in the spring by running and flying and in autumn by running only. The weevils pair soon after emergence and oviposit from May until August, when they die. In the laboratory, 73 females laid an average of 400 eggs each, and the maximum for a single female was 1,665. The eggs, which are described, are dropped indiscriminately on the soil and hatch in 10–21 days. By applying Dyar's law [*cf.* **20** 579], it was calculated that the larvae pass through four instars. They penetrate the soil to a depth of 7 ins., but most of them are found at 2–3 ins. The fourth-instar larvae migrate upwards, and the pupae are in the topmost inch of soil. Observations showed that about 15 days were spent in the third instar and 16 in the fourth ; the pupal period lasted 8–10 days. Adults of the new generation emerge from late July, with a peak in early August. They feed actively but do not mate, and enter hibernation when the first frosts occur. In 1945, few eggs laid after 1st July survived, apparently owing to the hot, dry conditions on the soil, and the potential increase was thereby reduced by some 75 per cent.

Beauveria bassiana killed a few of the weevils entering hibernation in 1944, and had killed 27 per cent. of those found on 30th May, 1945 ; another fungus, *Fusarium scirpi* var. *acuminatum*, was also isolated from the weevils in spring but *Beauveria* appeared to be the primary parasite. No insect parasites were observed.

Ploughing to a depth of 5 ins. in early August, after the hay crop was removed and while the majority of weevils were still in the pupal stage, reduced emergence by 42 per cent., whereas one-way disking to a depth of 5 ins. reduced it by only 5 per cent. Shallow cultivation might be more effective by exposing larvae to desiccation and heat. The percentage reductions in emergence from hibernation effected by various cultural operations in October were 91 for ploughing 6 ins. deep, 75 for ploughing 3 ins. deep, 65 for cultivating 3 ins. deep and 25 for one-way disking 3 ins. deep, and all the operations delayed the peak of emergence until early July. Crop rotation and planting of seedling sweet clover at a distance from that grown for hay are recommended.

A dusting of 3 per cent. DDT gave significant control in a field test in 1945 and was more effective than the other materials tested, but the use of insecticides is not economic on sweet clover.

FREEMAN (T. N.). **A new generic Assignment for** *Archips fumiferana* **(Clemens), the Spruce Budworm (Lepidoptera, Tortricidae).**—*Canad. Ent.* **79** no. 2 p. 21. Guelph, Ont., 1947. **The external Anatomy of the Spruce Budworm** *Choristoneura fumiferana* **(Clem.) (Lepidoptera, Tortricidae).**—*T.c.* pp. 21–31, 12 figs., 17 refs. **The Correction of a genotypic Citation for the Genus** *Choristoneura* **Led.**—*Ent. News* **59** no. 8 p. 202. Lancaster, Pa., 1948.

In the first paper, for reasons that are to be given in a forthcoming taxonomic paper, *Harmologa* (*Archips*) *fumiferana*, Clem., is transferred to the genus *Choristoneura*, Lederer, of which the genotype is stated in the third paper to be *Tortrix diversana*, Hb. The second paper contains details of the structure of

the adults, given because the species is considered representative of the subfamily ARCHIPINAE, a revision of the North American species of which is being prepared.

HANDFORD (R. H.). **The Use of DDT in Cutworm Control.**—*Canad. Ent.* **79** no. 2 pp. 36–37. Guelph, Ont., 1947.

In May 1946, DDT was used by seed growers in a district in British Columbia as an emergency measure for the control of cutworms, mostly *Euxoa ochrogaster*, Gn., with a few *E. tessellata*, Harr., and other related species. Preliminary observations on 22nd May, particularly in a lettuce field in which a 3 per cent. DDT dust had been applied at the rate of about 40 lb. per acre, suggested that excellent control was obtained, and further observations were accordingly carried out during the next ten days.

In most of the fields examined, a dust containing 3 per cent. DDT had been used at rates varying from about 40 to 230 lb. per acre, but other treatments included a spray prepared from a wettable powder containing 50 per cent. DDT, a mixture of the wettable powder and the 3 per cent. dust to give 4 per cent. DDT, and a dust containing 10 per cent. DDT. By 27th May, mortality was little more than 50 per cent. in most instances, which was similar to or slightly higher than the average mortality estimated for single applications of poison bait, but it appeared to be fairly complete in the lettuce field and in two onion fields. In one of these, the 3 per cent. dust had been applied at a rate probably exceeding 50 lb. per acre, on or about 10th May, to a portion of the field showing considerable cutworm injury, while hand-picking had been carried out in the remainder. On 23rd May, the stand of onions was much better in the dusted that in the hand-picked portion of the field ; no cutworms could be found in the dusted section, and only a few in the remainder of the field, which suggested that hand-picking had been fairly effective but too slow to prevent marked injury. In the second field, in which large seed onions were grown, observations up to 27th May indicated that a 4 per cent. DDT dust applied on 23rd May at 115 or 230 lb. per acre had given about 60 per cent. control. Since exceptionally heavy rain had fallen on 25th May, a few of the rows previously dusted at 115 lb. per acre were dusted again next day at 200 lb. In daily counts up to 1st June, only one living cutworm was found on two sampling plots dusted twice as compared with 24 dead, despite another heavy shower 24 hours after the second dusting. Between 27th May and 1st June, a further 14 dead and 2 living cutworms were obtained from the plot dusted once at the lower rate and 15 dead and 8 living from the one treated once at the higher rate.

Treatment with DDT is more expensive than poison baits, but these results suggest that a thorough application of DDT will kill cutworms that appear above ground for too short a time to take bait and that it remains effective for a much longer period. It may also be effective against climbing cutworms that spend little time on the ground. On the other hand, despite the variable results obtained by some growers with poison bait, this should still be used for controlling early stages and especially for eliminating infestations before the crop appears.

SALT (R. W.). **Some Effects of Temperature on the Production and Elimination of Diapause in the Wheat Stem Sawfly, *Cephus cinctus* Nort.**—*Canad. J. Res.* (D) **25** no. 2 pp. 66–86, 2 figs., 7 refs. Ottawa, 1947.

The following is based on the author's introduction and abstract. *Cephus cinctus*, Nort., has one generation a year on wheat in Canada ; the larvae become mature in the stubs in late summer and enter an obligatory diapause that is eliminated by the time spring temperatures rise sufficiently for development to proceed [*cf. R.A.E.*, A **36** 390]. The diapause can, however, recur in

the spring, especially under drought conditions or in stubble fields in which shallow tillage has raised the infested stubs to the soil surface. Small numbers of larvae in spring diapause are commonly found throughout western Canada as a result of localised drought conditions in their microclimates. Soil erosion by wind or water tends to expose stubs to subsequent heat and desiccation, and larvae in such stubs are more likely to re-enter diapause than those in stubs with the normal protection of the surrounding soil.

It was shown that the ending of the obligatory diapause involves the elimination of two factors, of which the first, or *x* factor, is eliminated only at subdevelopmental temperatures and has a positive temperature coefficient in a temperature range from the undercooling point up to the developmental threshold. The second, or *y* factor, is eliminated at either low or moderate temperatures, having a positive coefficient in a temperature range from the undercooling point up to about 30°C. [86°F.]. When the *x* factor reaction is complete, diapause may be said to be " broken ", but it is not " eliminated " until the *y* factor reaction is complete. If the *y* factor is still present, the insect can be returned to diapause by either high temperatures or a lack of adequate moisture, or a combination of these. This sometimes occurs in nature, resulting in a two-year life-cycle [*cf.* **34** 181]. Once the *y* factor has been eliminated, the insect starts post-diapause development and can no longer return to a state of diapause. Under constant favourable conditions, post-diapause development is rather uniform once it has begun, but the time of its initiation is variable, being dependent on the *y* factor. Evidence is presented that indicates that the *y* factor is eliminated faster in large larvae than in smaller ones, which accounts for the rather wide variability in development in examples uniformly treated but not selected as to size.

At 10°C. [50°F.], roughly 40 to 110 days were required to break diapause, each larva requiring a definite conditioning period. Thus the process ends abruptly in individuals, but gradually in a group. Under natural conditions in 1945–46, diapause was broken as early as 19th October in a few cases and by the end of January in all.

West jr. (A. S.). **The California Flatheaded Borer** (*Melanophila californica* **Van Dyke**) **in Ponderosa Pine Stands of northeastern California.**—*Canad. J. Res.* (D) **25** no. 3 pp. 97–118, 4 pls., 2 figs., 14 refs. Ottawa, 1947.

The following is based largely on the author's summary. The frequent occurrence of *Melanophila californica*, Van Dyke, in the commercial pine stands of north-eastern California and the lack of specific information about its life-history and habits led to an investigation of this Buprestid as a step to determining its place and importance in the so-called western pine-beetle problem [*cf. R.A.E.*, A **29** 551]. It infests several species of pine, but is important in California chiefly because it is concerned in insect-caused losses in valuable mature stands of *Pinus ponderosa* and *P. jeffreyi*.

The eggs are laid in bark crevices on living trees from about mid-June to the end of August. The larvae bore through the phloem to the cambium region, where they feed on living tissues for a period varying from a few months to a maximum of about four years. In general, most of the larvae spend one, two or three years in the cambium region in what has been termed the incipient stage [*cf. loc. cit.*]. Ultimately these larvae die if the tree does not, or if the tree dies they pass to a fast-growing stage in which feeding is extensive and growth is rapid. Usually fast-growing larvae are found from mid-June to mid-October but may occur at any time of the year. The prepupae appear in the outer bark late in July, but pupation does not occur until April and May of the following year. Adults are active from late May until early August.

Relatively few parasites and predators of *M. californica* have been encountered. An undescribed Encyrtid parasitised the eggs immediately after they were laid, but the percentage parasitism was only 2·9. Larvae of Clerid and Trogositid predators, chiefly *Thanasimus nigriventris*, Lec. (*lecontei*, Wolc.) and *Temnochila virescens*, F., have been observed attacking the larvae in infested trees, and woodpeckers destroy a considerable proportion of the overwintering prepupae.

Infestations in standing trees are complicated by the occurrence of successive attacks over a period of years, so that larvae of different ages live together in the cambium region. The situation is further complicated by supplementary attacks by several species of bark-beetles. Standing trees are infested in significant numbers. The older, decadent or unhealthy trees have a higher incidence of infestation, but thrifty and vigorous trees are not immune to attack. Adults have also been reared from slash or cull logs from trees infested while living and from wind-thrown and injured trees.

POUND (G. S.). **Beet Mosaic in the Pacific Northwest.**—*J. agric. Res.* **75** no. 1 pp. 31–41, 3 figs., 18 refs. Washington, D.C., 1947.

Garden beet grown for seed in the Puget Sound area of Washington is attacked by a mosaic disease that causes losses of up to more than half the crop, and investigations were made in 1943–45 on the identity, host-range, symptoms and transmission of the virus and the control of the disease, which was also observed in the Willamette Valley in Oregon. The following is based on the author's summary of them. The virus is thought to be identical with that of the sugar-beet mosaic reported from other parts of the United States, including California, Idaho and Colorado [*cf. R.A.E.*, A **10** 242 ; **21** 536], but different from the virus reported to cause beet mosaic in Europe [*cf.* **15** 111 ; **22** 436], which has a much wider host range and distinctly different physical properties. The virus studied was found to infect all the chenopodiaceous plants tested by mechanical inoculation, but only nine species in seven of 20 other families, including *Zinnia elegans* and *Amarantus retroflexus*, which together with beet and spinach are considered to be the primary natural hosts.

The virus was readily transmitted by mechanical means and by *Aphis fabae*, Scop., and *Myzus persicae*, Sulz., which are common in the beet fields. *A. fabae* develops abundantly on seed beet and wild chenopodiaceous plants during midsummer and migrates from them to the young steckling beds, while *M. persicae* is probably responsible for the spread of the disease to the plants of other families. Transmission was also obtained with *Brevicoryne brassicae*, L., but since that Aphid is not easily colonised on beet and spinach, it is not thought to be a common vector. Though the virus has been recovered from semi-mature seed, evidence has been obtained that it is not seed-borne.

Practical control of the disease was obtained by planting steckling beds at a distance of over 5 miles from diseased seed fields.

PAPERS NOTICED BY TITLE ONLY.

JACKS (H.) & WRIGHT (L.). **Soil Disinfection. VI. An Injector for applying small Dosages of volatile Fumigants to Soils.**—*N.Z.J. Sci. Tech.* **28** (A) no. 5 pp. 328–331, 4 figs. Wellington, N.Z., 1947.

WENZL (H.). **Zur Anwendung der Fehlerwahrscheinlichkeitsrechnung im Pflanzenschutzversuch.** [On the Use of the Calculation of the Probable Error in Plant Protection Experiments.]—*Pflanzenschutzberichte* **1** no. 3–4 pp. 49–59, 7 refs. Vienna, 1947.

Report of the Fifth COMMONWEALTH ENTOMOLOGICAL CONFERENCE,

22nd-30th JULY, 1948.

A detailed account of the Conference, together with the conclusions and resolutions arising from it.

A memorandum of the work of the Institute from 1935 to 1948 is given in Appendix I (pp. 14–19). The reports of the various Committees constitute Appendix II (pp. 20–26). Appendix III (pp. 27–112) consists of the proceedings of the scientific meetings, which are as follows :

Subjects	*Openers*
Recent Developments in Insecticides	R. A. E. Galley
Mode of Action of new Insecticides	V. B. Wigglesworth
Uses and Limitations of the new Insecticides in the Field	W. A. Ross
Recent Developments in Pest and Disease Control Machinery	H. G. H. Kearns G. H. Berkeley
Application of Insecticides from the Air ...	D. L. Gunn
Biological Control	A. B. Baird W. Cottier R. H. Le Pelley D. Miller
Estimation of Insect Populations in the Field	A. H. Strickland
Developments in the Control of Stored Products Insects	F. N. Ratcliffe
Tsetse Research and Control	T. A. M. Nash K. R. S. Morris
The Need for Plant Quarantine on a Continental Basis, with special Reference to Africa ...	G. F. Clay
History of the Bureau of Biological Control ...	Sir H. Howard
Locusts and Grasshoppers	B. P. Uvarov A. J. Nicholson
Discussion of Summary of Information on Termites	

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